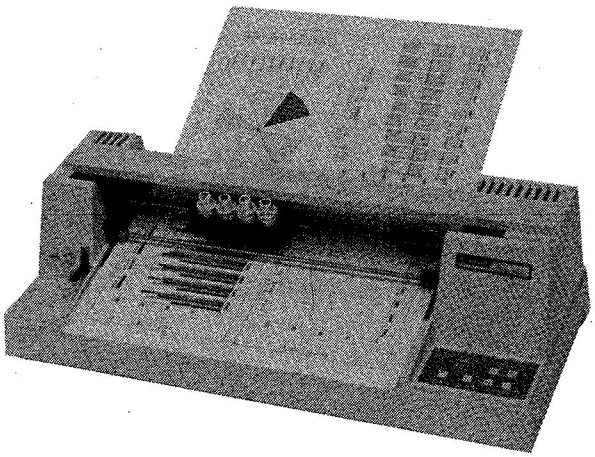
672-XD PLOTTER

OPERATING GUIDE

(MODEL 672-XD-[ ])



HITACHI

N-1318E-2
YN-T (MTT-NK)

The United States Federal Communications Commission (in 47 CFR 15.838) has specified that the following notice be brought to the attention of users of this product.

FEDERAL COMMUNICATIONS COMMISSION
RADIO FREQUENCY INTERFERENCE
STATEMENT

"This equipment generates and uses radio frequency energy and if not installed and used properly, that is, in strict accordance with the manufacturer's instruction, may cause interference to radio and television reception. It has been type tested and found to comply with the limits for a Class B computing device in accordance with the specifications in Subpart J of Part 15 of FCC Rules, which are designed to provide reasonable protection against such interference in a residential installation. However, there is no guarantee that interference will not occur in a particular installation. If this equipment does cause interference to radio or television reception, which can be determined by turning the equipment off and on, the user is encouraged try to correct the interference by one or more of the following measures:

——reorient the receiving antenna
——relocate the computer with respect to the receiver
——move the computer away from the receiver
——plug the computer into a different outlet so that computer and receiver are on different branch circuits.

If necessary, the user should consult the dealer or an experienced radio/television technician for additional suggestions. The user may find the following booklet prepared by the Federal Communications Commission helpful:

'How to Identify and Resolve Radio-TV Interference Problems'.
This booklet is available from the US Government Printing Office, Washington, DC 20402, Stock No. 004-000-00345-4."

WARNING

To comply with the class B limits, it is necessary to use shielded interface cable in connecting this plotter with computers.
Operation with unshielded interface cable is likely to result in interference to radio and TV reception.

WARNING

1. Disconnect the AC power cord from power source before removing the cover and performing any maintenance. (For service personnel only)

2. Fuse replacement must be the same type and rating.

Line voltage	Fuse rating
120V AC	125V 1A
220V or 240V AC	250V 1A

3. To prevent fire or shock hazard, do not expose this product to rain or any type of moisture.

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1. INTRODUCTION

672-XD PLOTTER is a smart A3 size XY plotter that plots figures and characters under the control of tha small computer or personal computer.
The pen moves in horizontal direction, while the paper slides in vertical direction.
That makes the construction simple, consequently this plotter has excellent features of small size, high speed, high performance, multi-color and low cost.
Can be suitably used as the multi-color recording device for computer graphics : business graph, data recording, CAD system, educational use etc..

Features

(1) Light and small, A3 size desk-top plotter which employs the system with which the paper is moved back and forth by friction rollers.
High reliability is provided by simple construction.

(2) Both Centronics compatible 8-bit parallel interface and RS-232-C serial interface are provided as standard features.
This enables combination with various types of computers.

(3) Firmware of drawing commands enables the plotter to be driven by many kind of presentation softwares written with HP-GL (Hewlett-Packerd Graphics Language).

(4) Fiber-tip pen and ceramic pen are appropriately selectable according to drawing object.

(5) Oil-based fiber-tip pens enable drawing colorful graphs or pictures on transparency film.

(6) Includes 56 kinds of HP-GL based commands, which are the same as Model HP7475A plotter.
(1) Digitizing function available.
(2) Outputs the plotter conditions in replying to the output commands.

(7) Four modes of RS-232-C handshaking available : hardwire, Xon-Xoff, ENQ-ACK and software-controlled handshaking.

2. PRECAUTIONS

For making the best use of the functions of this plotter, keep the following points in mind.

(1) Select an installation place which meets the requirements listed below.

- O Free from mechanical vibrations and electrical noise.
- O Free from dust and high humidity (humidity should be within 45 to 85% RH).
- O Protected from direct sunlight and drafts.
- O A normal temperature (20℃) is maintained, with little temperature variation.
- O Place the plotter on a level and solidly-built stand or desk.

(2) Do not move the paper or the pen carriage by hand when the power is ON. Be sure to move them via the position switches (on the control panel). If moving them by hand is unavoidable, turn the power OFF first and then move them gently.

(3) Observe the following with regard to pen handling.

- O Mount the pens to the pen carriage before supplying power.
- O After finishing a drawing, put the pens in the pen storage, and put caps on them if they will be left unused for a long time . Take care about the oil-based fiber-tip pen in particular, for it dries quickly.

(4) When connecting the plotter to a computer for the first time, be sure to conduct a self-test for trial drawing and confirm that the plotter functions properly.

(5) When the table or the platen is stained with ink etc., wipe it off with a water or alcohol-soaked soft cloth or tissues. Solvents such as thinner or trichloroethylene should not be used for this.

(6) Do not touch the table with hands when a drawing is under way.

3. OUTLINE AND NAMES OF PARTS

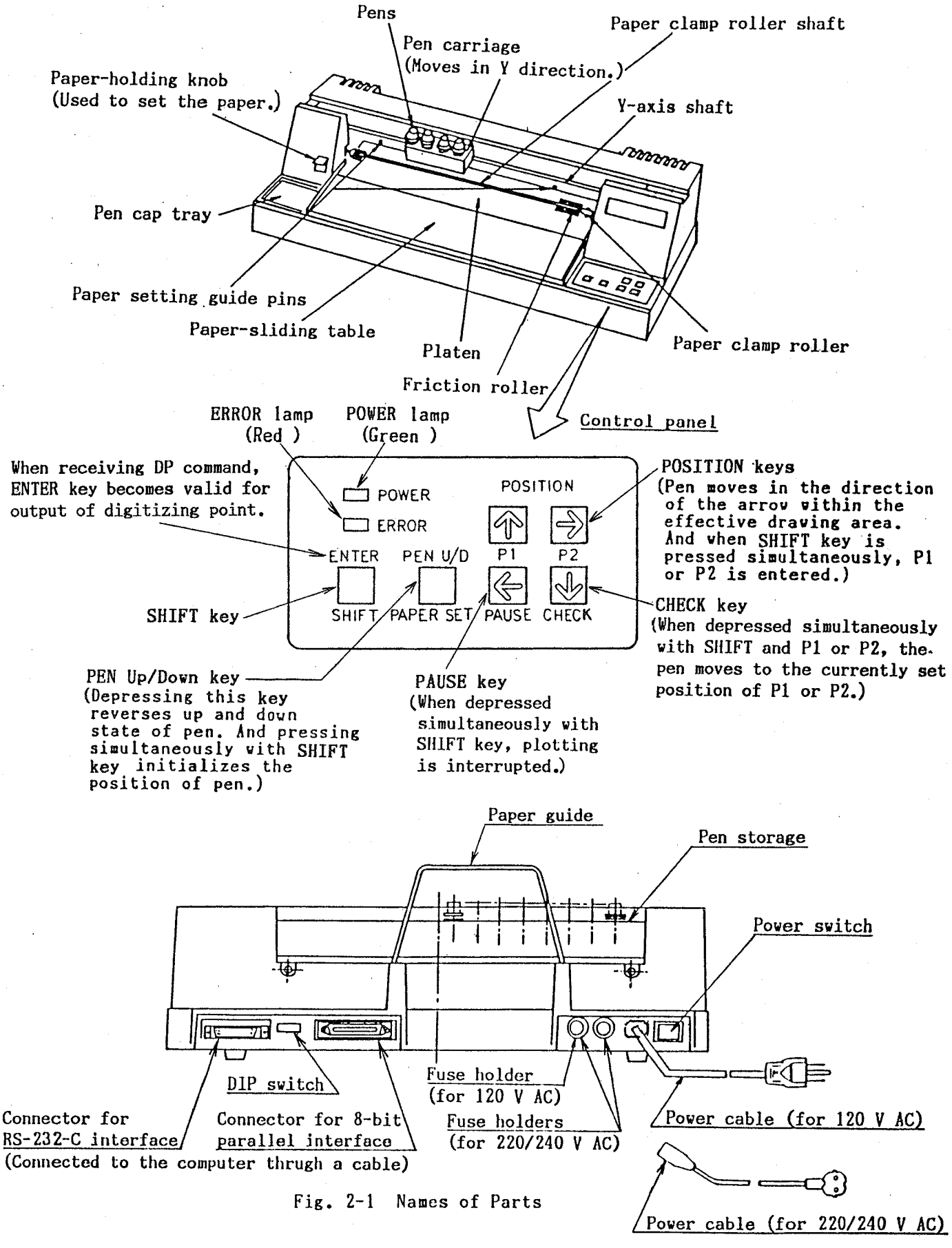


Fig. 2-1 Names of Parts

4. PREPARATION FOR DRAWING

4.1 Power Turn-on

Make sure first that the power switch is OFF and then connect the power cable to an AC power source.
Turn the power switch ON, and the power lamp lights and the pen carriage moves to the left which is a drawing origin.

4.2 Pen Setting

The plotter is provided with aqueous fiber-tip pens as accessories. Take off the pen caps and put the pens in the pen carriage (Fig. 4-1).
Don't set or take off the pen at the position of the pen lever. Before setting or taking off the pen at the pen lever position, move the pen carriage to the left or right side so that the pen lever moves to other pen position.
Set the pens so that the pen lever rides on the pen upper flange.
Take care in that incorrect pen setting may cause erroneous operation or trouble. Put the pen caps on the pen cap tray so as not to lose them.
After drawing, put the pens in the pen storage, and put the caps on them if they will be left unused for a long time.

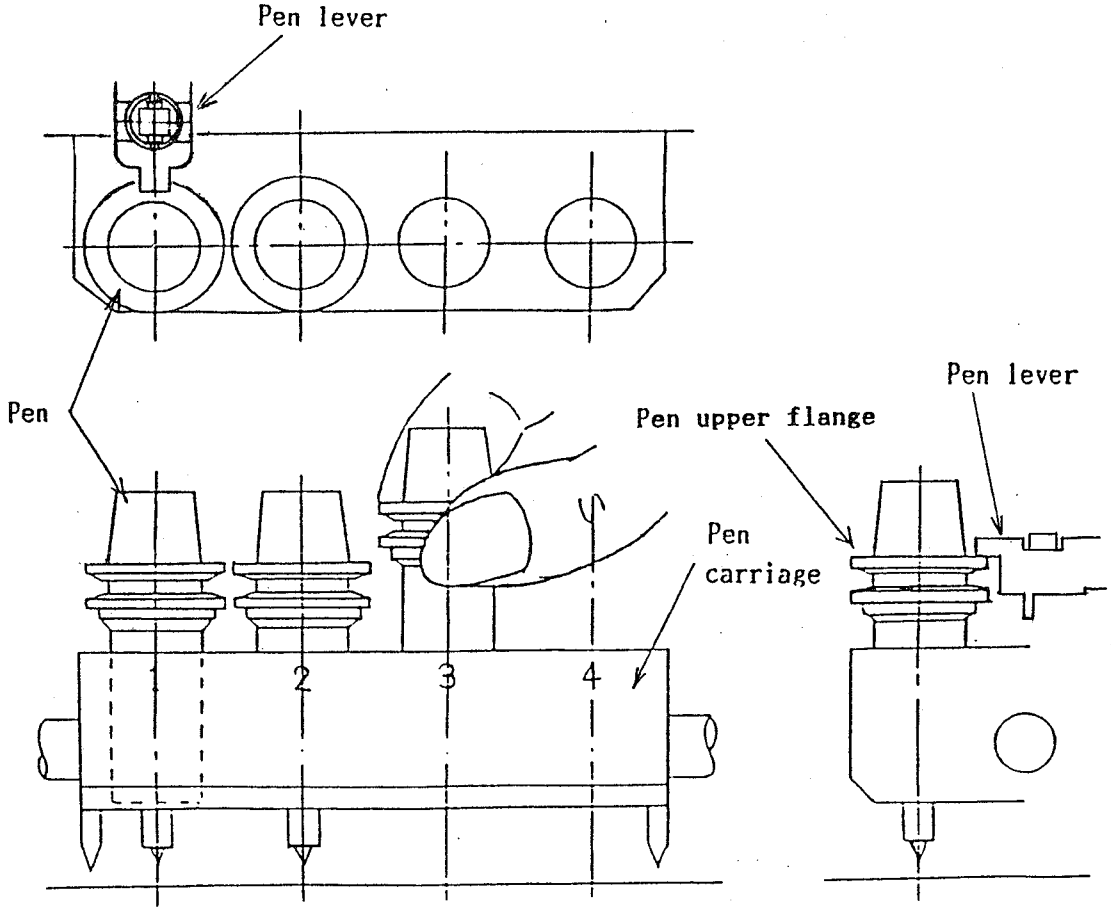


Fig. 4-1 Pen Setting

How to set a ceramic pen (CERAMICRON of Pentel Co.)

Pen holder consists of two pieces (holders Ⓐ and Ⓑ). Referring to Fig. 4-2, insert both ends of the ceramic pen into holders Ⓐ and Ⓑ. Then screw the holder Ⓑ into the holder Ⓐ. Set the ceramic pen with pen holder in the same manner as the fiber-tip pen. After drawing, put the ceramic pen in the pen storage with pen holder, but if it will be left unused for a long time, then put on the cap after taking off the pen holder.

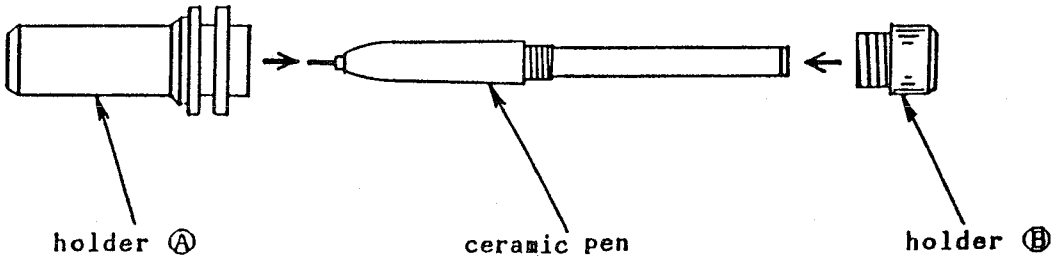


Fig. 4-2 Ceramic Pen Setting

4.3 Paper Setting

(1) Lift the paper-holding knob to load the paper (Fig. 4-3).

(2) Move the paper clamp roller to the right for ISO A3 or A4 size paper, and to the center of movable width for ANSI A or B size paper (Fig. 4-4).

(3) Set the paper on the platen by aligning the paper top with the paper setting guide pins. When the paper is A3 or B size, the paper top is the short side. When the paper is A4 or A size, the paper top is the long side (Fig. 4-4). Take care that the paper does not wrinkle or loosen.

(4) Push down the paper-holding knob, and the paper is held.
The paper setting is completed.

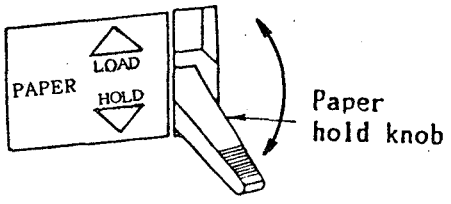
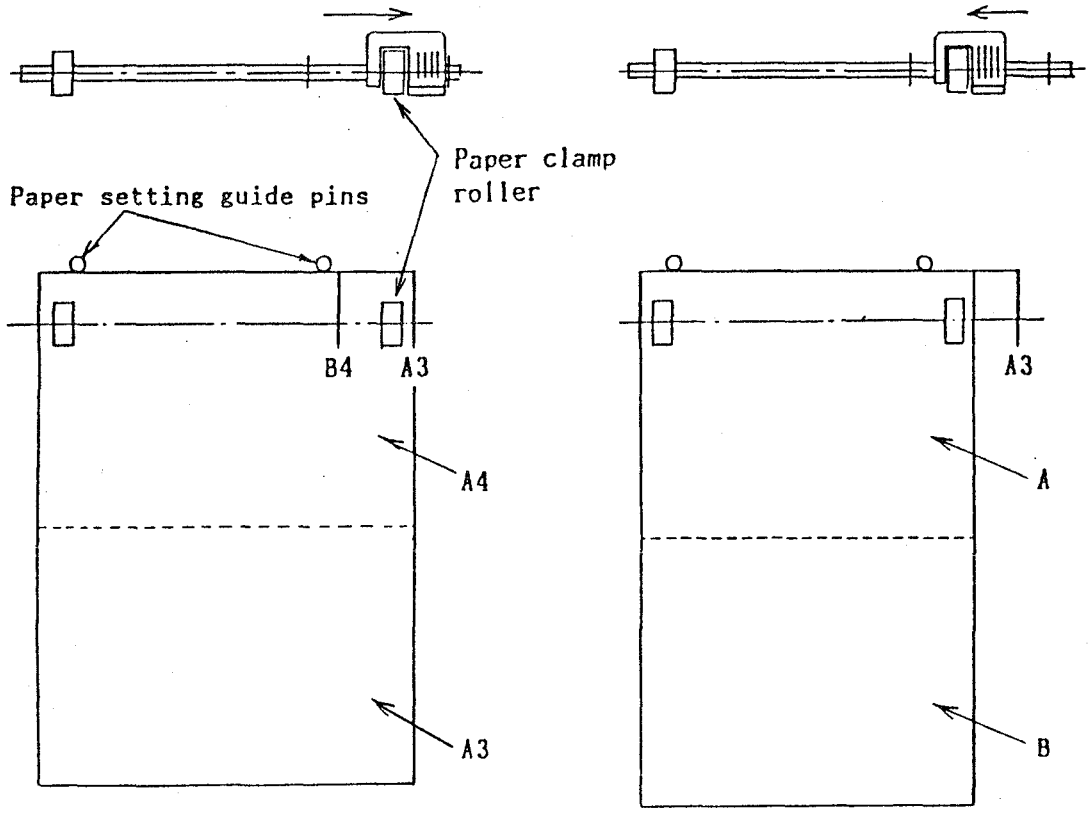


Fig. 4-3 Paper-holding knob



(a) ISO A3 or A4 size paper (b) ANSI A or B size paper

Fig. 4-4 Paper Setting

4.4 Manual Operation Check

(1) Manipulate the POSITION keys on the control panel. It is all right if the pen carriage moves in the depressed key direction within the effective drawing area of the paper. The pen carriage never goes outside of the area even if depressing the key. In case two keys are depressed at the same time, [↓] takes precedence concerning the X-axis direction while [→] takes precedence in the Y-axis direction (Fig. 4-5).

Do not move the pen carriage by hand when the power is ON, because the pen carriage may be damaged mechanically, resulting in troubles.
If moving the pen carriage by hand is unavoidable, turn the power OFF first and move it gently.

Up/down of the pen can be reversed by depressing the PEN Up/Down key. However, the pen automatically rises unless the POSITION keys and PEN Up/Down key are depressed within approx. 2 seconds after lowering the pen.
The manual operation check is thus finished.

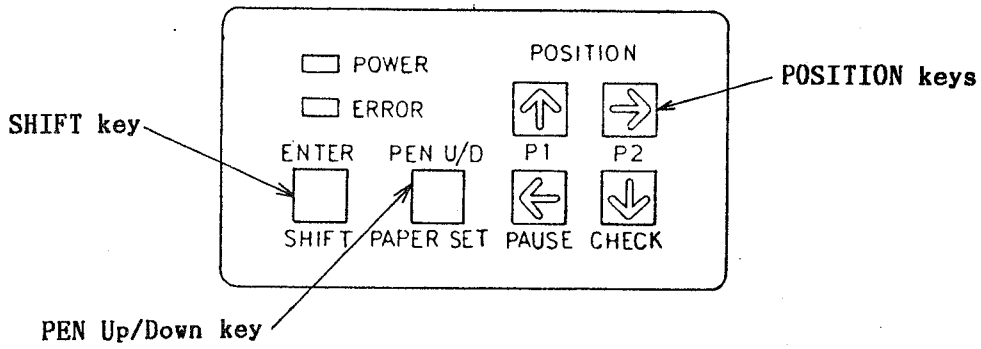


Fig. 4-5 Control Panel

(2) Special Function

a. PAUSE	Returns the pen to the upper position on the paper and interrupts drawing.
b. ENTER	Used to output the digitizing point after receiving DP command.
c. [↓] + Power ON	While depressing [↓] key, turn the power switch ON, and plotting speed set to 125 mm/s.
d. [←] + Power ON	While depressing [←] key, turn the power switch ON, and the XY coordinate system rotated as much as 90°.
e. [↓] + [←] + Power ON	While depressing [↓] and [←] key, turn the power switch ON, and plotting speed set to 125 mm/s together with the XY coordinate system rotation of 90°.

4.5 Self-Test

Next, self-test patterns must be drawn for an operational check of drawing commands. Turn the power OFF first and then make sure the chart is set, and pens (4 pcs.) are provided.

Then turn the power ON while depressing POSITION keys ← and → (Fig. 4-6) followed by depressing POSITION keys for about 5 seconds, and the plotter draws self-test patterns shown in Fig. 4-7.

Drawings are not made by depressing the POSITION keys after turning the power ON.

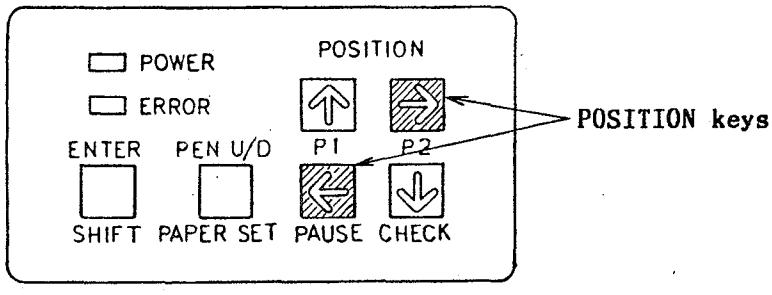


Fig. 4-6 Control Panel

The plotter is functioning normally if it can draw the same patterns as illustrated in Fig. 4-7. Drawing of these self-test patterns is repeated until the power is turned OFF.

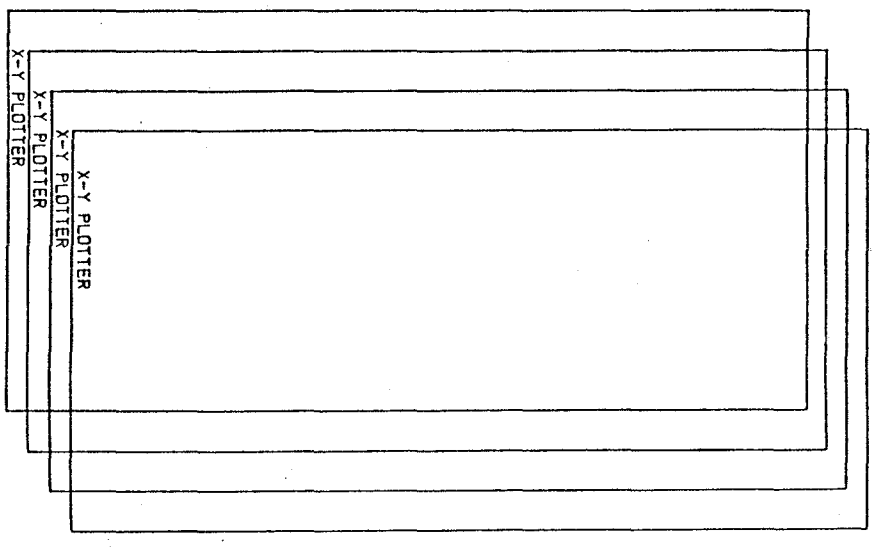


Fig. 4-7 Self-Test Patterns

4. 6 Print Mode

(1) Print Mode Setting

Set the plotter into a print mode in the following manner.
First, make sure that the power is OFF, and then turn the power switch ON while depressing the POSITION keys, either [↑] or [↓] (Fig. 4-8). Then the pen carriage moves up to the top position and stops there. Next, set the chart and pen 1 (with the print mode, only pen No. 1 is used).

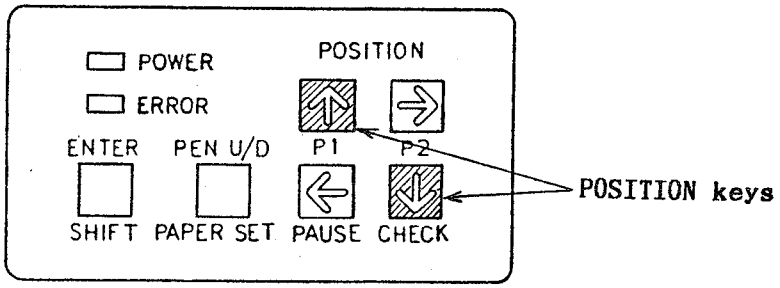


Fig. 4-8 Control Panel

(2) Print Mode Definitions

As the ASCII code is keyed in, the pen begins printitng the keyed-in characters from the top left in the effective drawing area. when any code not contained in the ASCII code table is keyed in, it is regarded as a space. A new line is started when a terminator LF (line feed) is keyed in and the print is continued. If the next data are not keyed in within 2 seconds after the line feed, however, the pen carriage goes back its original position. Afterwards when a character code is keyed in, the pen resumes printting from the position of new line.
The size of printed characters is 1.75 mm wide by 2.55 high. And the direction of character printing is parallel with the paper moving direction. When the paper size set with the DIP switch at the rear of the plotter is A or B, up to 48 lines of characters, with 68 characters per line, can be printed.

When A4 or A3 size is set, up to 52 lines containing 64 characters each can be printed. When the printing of the 48 or 52 lines is finished, the A or A4 size paper is fed one page and then the pen goes to the top right and stops. So with the A or A4 size the paper comes out at the top, and it is necessary to set the next paper in place. But with B or A3 size the pen waits for writing at the lower half of the remaining blank space of the paper. If it is necessary to keep on printing further, depress any one of POSITION keys ← → ↑ ↓ and the pen carriage once again begins printing from the top of the page.

The Table 4-1 gives the number of pages and characters per page for each paper size.

Table 4-1 Number of characters printed

Paper size	No. of pages	Characters / page
ANSI A	1	68 characters x 48 lines
ANSI B	2	
ISO A4	1	64 characters x 52 lines
ISO A3	2	

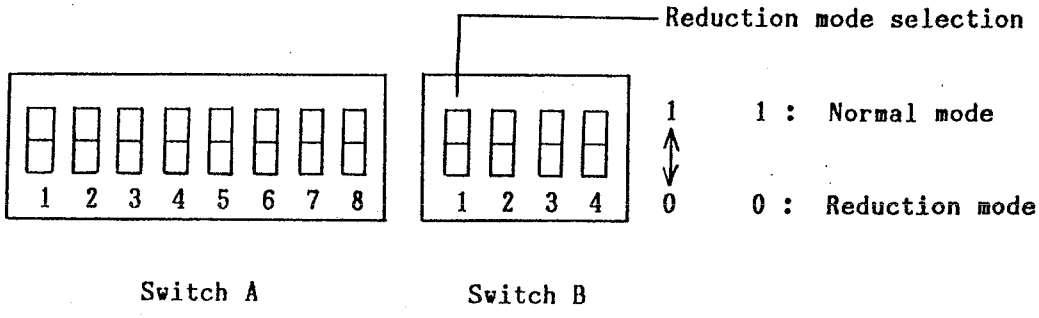
In the print mode, inputs from POSITION keys, SHIFT key and PEN Up/Down key are ignored.

To cancel the print mode, turn the power switch OFF.

4. 7 Reduction Mode

(1) Reduction Mode Setting

Reduction mode is selected by DIP switch B No.1.



(2) Reduction Mode Definitions

In this mode the coordinate values and character sizes are reduced to 90% of input values.

In reduction mode the maximum plotting area and the locations of P1 and P2 differ from normal mode. (see Table 4-2 to Table 4-4)

Table 4-2 Maximum plotting area

Mode	Normal		Reduction	
Paper size	X	Y	X	Y
A	10000	7200	10365	7962
B	15600	10000	16640	10365
A4	10800	6800	11040	7721
A3	15200	10800	16158	11040

NOTE:1plotter unit = 0.025 mm

Table 4-3 Location of P1 and P2 (Normal Mode)

	RO 0; (Normal)				RO 90; (Normal)			
Paper size	P1X	P1Y	P2X	P2Y	P1X	P1Y	P2X	P2Y
A	318	0	9762	6800	160	318	6960	9762
B	400	0	15600	10000	0	0	10000	15200
A4	678	0	10122	6800	0	678	6800	10122
A3	0	400	15200	10400	400	0	10400	15200

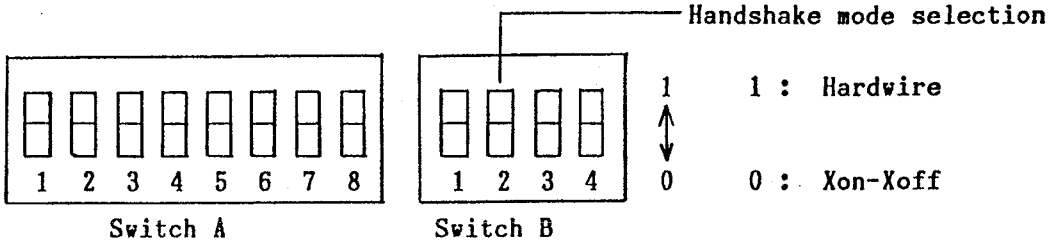
Table 4-4 Locations of P1 and P2 (Reduction Mode)

	RO 0; (Reduction)				RO 90; (Reduction)			
Paper size	P1X	P1Y	P2X	P2Y	P1X	P1Y	P2X	P2Y
A	250	596	10250	7796	154	244	7354	10244
B	522	259	15722	10259	283	934	10283	16134
A4	603	521	10603	7721	0	610	7200	10610
A3	170	602	15370	10602	607	797	10607	15997

4. 8 Handshake mode

(1) Handshake Mode Setting

Xon-Xoff handshake is selected by DIP switch B No.2.



In the Hardwire handshake , the handshake is done by using Data Terminal Ready (DTR , pin 20).
When the Xon-Xoff handshake is selected , the plotter holds DTR line high all the time and the maximum pen speed is 125 mm/sec.

(2) Handshake Conditions

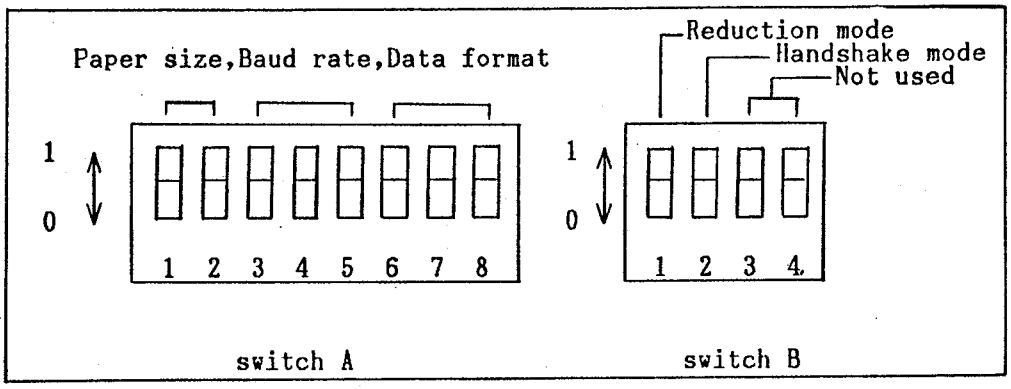
The following conditions of Xon-Xoff handshake are fixed when Xon-Xoff mode is selected.

Buffer size ..... 512 Bytes
Xon trigger character ..... DC1 (decimal equivalent 17)
Xoff trigger character ..... DC3 (decimal equivalent 19)
Xon threshold level ..... 128 Bytes
Xoff threshold level ..... 384 Bytes

Xon-Xoff handshake is used when the external computer can not monitor the DTR signal. The plotter prevents loss or error in the data tansfer as follows.
When the remaining space in the data buffer is 128 bytes or less , the plotter sends the Xoff character (DC3) to the external computer. The external computer suspends the transfer of data. Then the plotter processes the data in the buffer , and when remaining space in the buffer reaches 384 bytes or more , the plotter sends the Xon character (DC1). The external computer restarts the transfer of data upon receiving the Xon character.

4. 9 Interface Condition and Paper Size Setting

DIP switch



By changing over DIP switch on the rear lower part of the plotter shown in the above figure, paper size and interface condition can be set. DIP switch must be changed over with power OFF. Otherwise, any conditions are not changed.

(1) Data Format Selection (only for RS-232-C)

Data format is selected on the basis of the RS-232-C serial interface by DIP switch A No.6 through No.8.

No.6	No.7	No.8	Start bit	Data bit	Parity bit	Stop bit
0	0	0	1	7	Even	2
1	0	0	1	7	Odd	2
0	1	0	1	7	Even	1
1	1	0	1	7	Odd	1
0	0	1	1	8	None	2
1	0	1	1	8	None	1
0	1	1	1	8	Even	1
1	1	1	1	8	Odd	1

(2) Baud Rate Selection (only for RS-232-C)

Baud rate is selected on the basis of the RS-232-C serial interface by DIP switch A No.3 through No.5.

No.3	No.4	No.5	Baud rate
0	0	0	300 bauds
1	0	0	600 bauds
0	1	0	1200 bauds
1	1	0	2400 bauds
0	0	1	4800 bauds
1	0	1	9600 bauds

(3) Paper Size Selection

Paper size is selected by DIP switch A No.1 and No.2

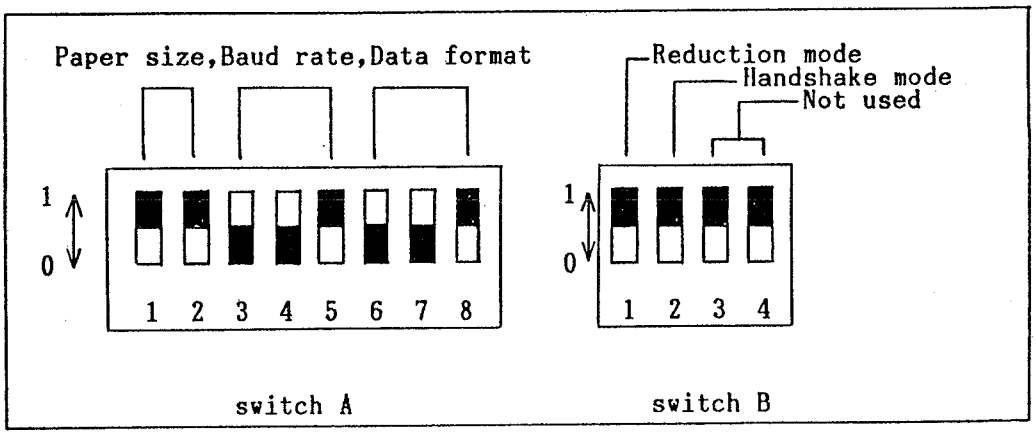
No.1	No.2	Paper size	Maximum Plotting Range (plotter units)	
			X axis	Y axis
0	0	ANSI A	0 - 10000	0 - 7200
1	0	ANSI B	0 - 15600	0 - 10000
0	1	ISO A4	0 - 10800	0 - 6800
1	1	ISO A3	0 - 15200	0 - 10800

NOTE: 1 plotter unit = 0.025 mm

(4) Setting of DIP Switch Before Shipment

The DIP switch has been set as follows before shipment.

DIP Switch

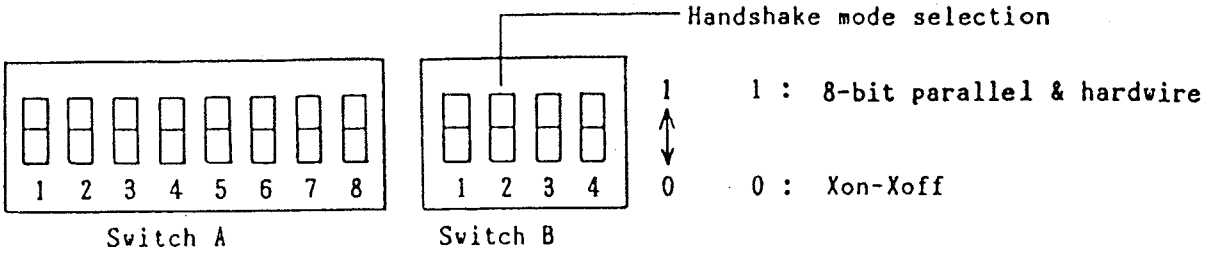


Paper size : A3
Baud rate : 4800 bauds
Parity : none
Data bit : 8 bits
Stop bit : 2 bits

Reduction mode : Normal
Handshake mode : Hardwire

NOTICE FOR 8-BIT PARALLEL INTERFACE

In case of 8-bit parallel interface,set DIP switch B No.2 to position "1".
Position "0" is only for Xon-Xoff handshake of RS-232-C interface.

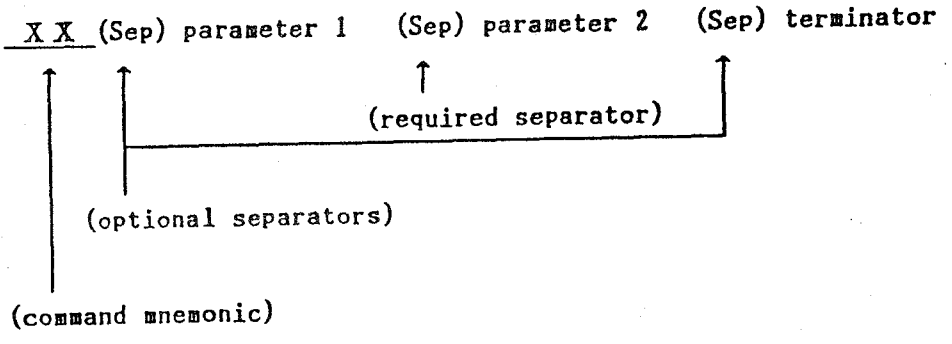


5. DRAWING COMMAND AND ITS FUNCTION

5.1 How to give parameters for drawing command.

This plotter is provided with 56 kinds of drawing commands. The commands consist of two-letter mnemonic uppercase or lowercase followed by parameters and a terminator.
The parameters must be separated from each other by at least one comma or space, or by a + or − sign.
A command is terminated by a semicolon, or by line feed code or by the next mnemonic.

Command syntax and its examples are shown below.



examples : PA1000␣1000;
PA100.5, −100.5;
PA32767, −32768(LF) (LF : line feed)

NOTE : The maximum parameter range that the plotter can calculate is -32768.0000 to +32767.9999.

The label command, LB, must be terminated with the label terminator character. This character defaults to the ETX code (ASCII end-of-text, equivalent to decimal 3). The label terminator may be changed from its default value using the DT command.

5.2 Unit systems

There are two unit systems which can be used to define points in the plotting area: plotter unit and user unit. Plotter unit is always the same size.
The size of a user unit depends on the parameters of the SC command and the settings of the scaling points, P1 and P2.

(1) The plotter unit

The plotting area is divided into plotter units; one plotter unit equals 0.025 mm (0.00098 in.). There are 40 plotter units per millimeter, or approximately 1016 plotter units per inch. One plotter unit is the smallest move the plotter can make. Parameters of plot commands between -32768 and 32767 plotter units are understood by the plotter. When plotting in plotter units, only integer values are used; parameters are truncated to integers.

(2) User unit

The plotting area can also be scaled into user unit. This is done with the scale commands, SC, which assigns values to the scaling points P1 and P2.
A user unit may be almost any size. The parameters of the SC command are truncated to integers between -32768 and 32767. Parameters of plot command must also be in that range but may be decimal numbers with fractional parts. Decimal fractions are not truncated.

(3) Scaling points P1 and P2

P1 and P2 are points which determine the plotting position and size. P1 and P2 are the two end points of a diagonal line of a rectangle, and there are two ways of setting them - manually by using key switches, and setting via IP command.
The values of P1 and P2 when power is turned on are set to the predetermined values in accordance with paper size selection explained in page 15.
The currently set positions of P1 and P2 can be checked manually by using the CHECK switch.
P1 and P2 are combined with an SC command. Such an SC command causes a set of coordinates (Xmin, Ymin) and another set (Xmax, Ymax) to be assigned to P1 and P2 respectively and defines a new coordinate unit (user unit). (See Fig. 5-1.)
The plotter handles the subsequent incoming coordinate data as data in user units.
The drawing can be expanded/contracted/shifted by use of data in user units.
As examples of expanding/contracting a drawing by using P1 and P2, execute the following:

```
IP0,0,10800,6800;
SC 0,270,0,170;
PU; PA0,0;
PD; PR100,0,0,100,-100,0,0,-100;
```

Then a square measuring 100 mm on each side will be plotted. Next, execute the following:

```
IP0, 0, 5400, 3400;
PU;  PA0, 0;
PD;  PR100, 0, 0, 100, -100, 0, 0, -100;
```

And a square measuring 50 mm on each side will be plotted.

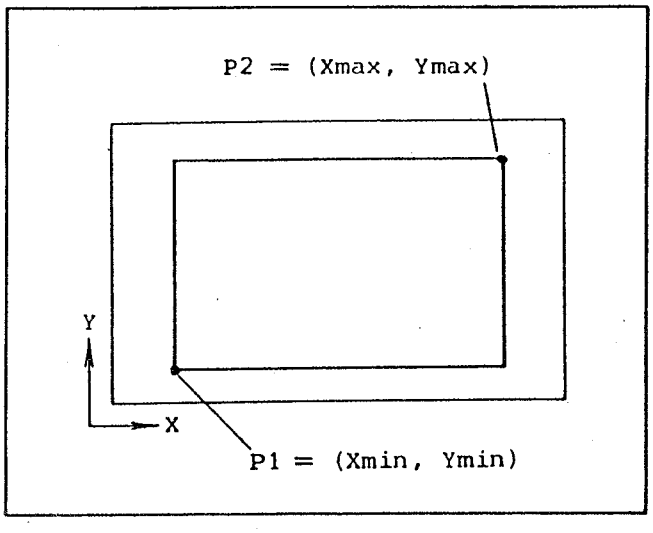


FIGURE 5-1 SCALING POINTS P1 AND P2

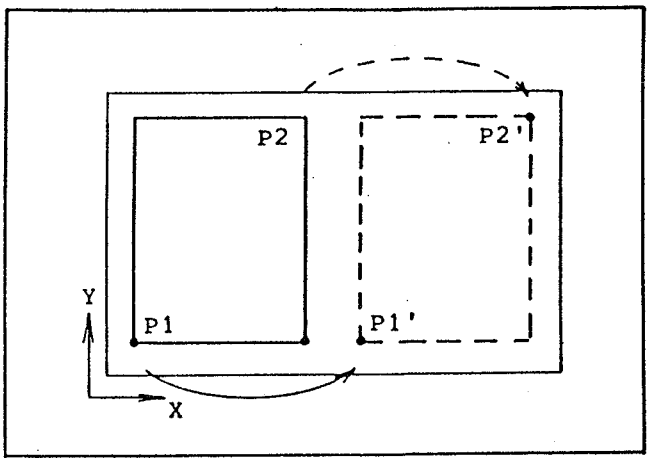


FIGURE 5-2 SHIFT OF DRAWING

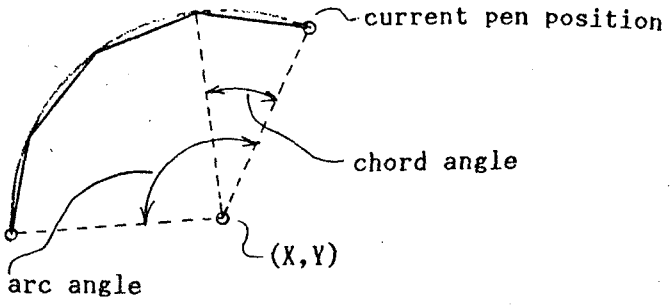
As shown in FIGURE 5-2, a drawing can also be shifted by using P1 and P2. First, make the desired drawing using the reference coordinates P1 and P2, then shift and set P1 at P1' position manually with key switches (P2 will automatically be shifted to P2'). Next, by executing the same drawing program, the drawing will be shifted parallel from the area shown by solid lines to the area shown by dashed lines.

5.3 Drawing Command

Command function and format are described below.

AA Arc absolute

Format : A A X,Y, arc angle(, or chord angle) ;
Description : Draws arc of specified number of degrees with specified smoothness; centered at X, Y coordinate, using current pen status(up or down).
Parameteres : X and Y — absolute coordinates.
arc angle — negative value specifies clockwise arc, positive value specifies counterclockwise arc.
chord angle — defines arc smoothness in degrees. Default is 5 degrees.



AR Arc relative

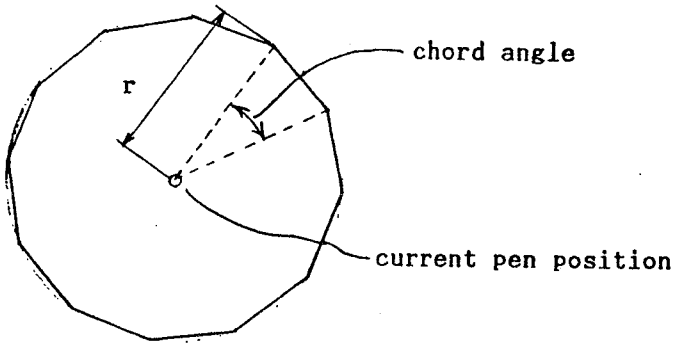
Format : A R ΔX, ΔY, arc angle(, or chord angle);
Description : Draws arc of specified number of degrees with specified smoothness; centered relative to current pen position, using current pen status(up or down).
Parameters : ΔX and ΔY — relative coordinates
arc angle — negative value specifies clockwise arc, positive value specifies counterclockwise arc.
chord angle — defines arc smoothness in degrees. Default is 5 degrees.

CA Designate alternate character set

Format : C A n ; or C A ;
Description : Defines the alternate character set.
If the alternate set is used as the current character set, a change is made immediately. If the standard set is used, no change is made until an S A command is executed.
Parameters : 0 to 4, 6 to 9, or 30 to 39; default set 0
(Refer to Table 5-2.)
If parameters are omitted, the set 0 is specified.

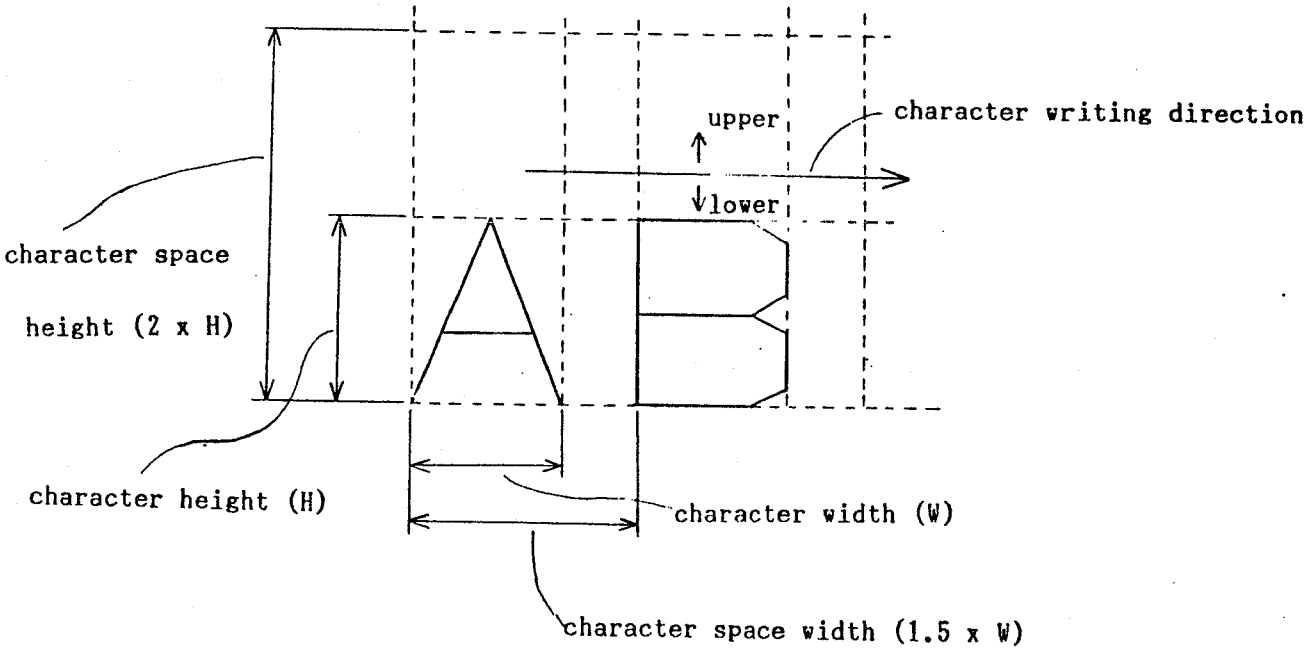
CI Circle

Format : C I r(, chord angle);
Description : Draws a circle centered at current pen position.
Parameters : r — radius.
chord angle — defines circle smoothness in degrees.
Default is 5 degrees.



CP Character plot

Format :C P m, n ; or C P ;
Description : Moves the pen with m character space widths horizontally, and n character space heights vertically.
Parameters : m — ≧ -128 and < 128, positive value moves pen in current character writing direction, negative value moves pen in opposite direction.
n — ≧ -128 and < 128, positive value moves pen to the upper side , negative value moves pen to the lower side in relation to current character writing direction.
Omitting parameters causes carriage return and line feed.



CS Designate standard set

Format : CS n ; or CS ;
Description : Defines the standard character set.
If the standard set is used as the current character set, a change is made immediately. If the alternate set is used, no change is made until as SS command is executed.
Parameter : 0 to 4, 6 to 9, or 30 to 39 ; default set 0
(Refer to Table 5-2)
If parameters are omitted, the set 0 is specified.

DC Clear digitizing mode

Format : DC ;
Description : The DC command releases the digitizing mode to disable entry of digitized points.
Execution of this command causes the ERROR lamp to go off, if no ERROR condition occurs.

DF Set default values

Format : DF ;
Description : Sets the plotter to a predefined conditions.
The plotter's functions after execution are listed below :

Function	Equivalent Instructions	Conditions
Plotting mode	PA ;	Absolute (PA)
Relative character direction	DR 1 , 0 ;	Horizontal (DR 1 , 0)
Line type	LT ;	Solid line
Line pattern length	LT ;	4 % of the diagonal distance between P1 to P2
Input window	IW ;	Set to current hard-clip limits
Relative character size	SR ;	Width = 0.75 % of (P2x - P1x) Heigth = 1.5 % of (P2y -P1y)
Symbol mode	SM ;	Off
Tick length	TL ;	tp = tn = 0.5 % of (P2x - P1x) for Y-tick and 0.5 % of (P2y - P1y) for X-tick
Standard character set	CS 0 ;	Set 0
Alternate character set	CA 0 ;	Set 0
Character set selected	SS ;	Standard
Character slant	SL 0 ;	0 degrees
Mask value	IM 2 2 3 ;	223
Scaling	SC ;	Scaling off
Pen velocity	VS ;	20 cm/sec.

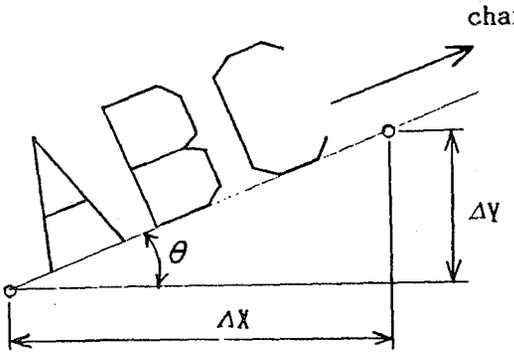
Function	Equivalent Instructions	Conditions
Label terminator	D T EXT;	EXT (ASCII decimal equivalent 3)
Fill type	F T ;	Set to type 1, bidirectional solid fill
Fill spacing	F T ;	1 % of the diagonal distance between P1 and P2
Fill angle	F T ;	Set to 0 degrees
Pen thickness	P T ;	Set to 0.3 mm

D I Absolute direction

Format : D I Δ X, Δ Y ; or D I

Description : Specifies character writing direction. Δ Y / Δ X is the slope from horizontal.

Parameters : Δ X, Δ Y — ≧-128 and <128.
Omitting patameters causes horizontal writing and is the same as ". D I 1, 0;".



$\theta = \tan^{-1} (\Delta X/\Delta Y)$

If only θ is known, Δ X and Δ Y are calculated as follows ;
Δ X = cos (θ)
Δ Y = sin (θ)

D P Digitizing mode

Format : D P ;

Description : The ERROR lamp flashes to indicate that the digitizing mode has been established.
- In the digitizing mode pressing the ENTER key turns off the ERROR lamp and sets the bit 2 of status value* to enable output of digitized point.
- Digitizing point is the current pen position.

(Note *) Refer to the explanation of O S command.

DR Relative direction

Format : DR ΔX, ΔY ; or DR ;
Description : Specifies character writing direction in relation to P1, P2 positions.
Parameters : ≧-128 and <128.
ΔX is % of (P2x - P1x), ΔY is % of (P2y - P1y).
Omitting parameters causes horizontal writing and is the same as "DR 1, 0 ;".

DT Define label terminator

Format : DT c ;
Description : Specifies the label terminator used in LB command.
Parameters : ASCII character 1 to 127. ETX (decimal 3) is default value.
Setting at default value can be accomplished by executing a DF command or IN or specifying ETX as a parameter for a DT command.

EA Edge rectangle absolute

Format : EA X, Y ;
Description : Draws the edge of a rectangle. The rectangle is formed by lines of the type specified by LT command. The pen returns to the original position upon completion of the drawing.
Parameters : (X, Y) are absolute coordinates.
They represent the coordinates of the corner diagonally opposite to the current position of the pen.

ER Edge rectangle relative

Format : ER ΔX, ΔY ;
Description : Draws the edge of a rectangle. The rectangle is formed by lines of the type specified by an LT command. The pen returns to the original position upon completion of the drawing.
Parameters : (ΔX, ΔY) are relative coordinates.
They represent the coordinates of the corner diagonally opposite to the current position of the pen.

EW Edge wedge

Format : EW r,s,a(,c);
Description : Draws the edge of a wedge. The pen is currently positioned at the pivot of the wedge. The pen returns to the original position upon completion of the drawing.

Parameter	Range	Default
r : radius	−32768.0000− +32767.9999	none
s : start angle	−32768−	none
a : sweep angle	+32767 (MOD 360)	
c : chord angle	1-120	5°

r — in plotter units unless scaling in effect ; then in X-axis user units. The sign of the radius defines the zero-degree reference point for the start angle and sweep angle.
s — a positive value positions the radius CCW from the zero-degree reference point ; a negative value positions the radius CW from the zero-degree reference point.
a — a positive value draws the arc segment CCW ; a negative value draws the arc segment CW.
c — defines arc smoothness in degrees.

FT Fill type

Format : FT (t, (, s (, a))) ; or FT ;
Description : Specifies a type of area fill for use at RA, RR and WG commands.

Parameter	Range	Default
t : fill type	1-5	1
s : spacing	0-32767.9999	1% of the diagonal distance between P1 and P2
a : angle	±45° increments from 0°	0°

t	Fill type
1	Solid ; bidirectional
2	Solid ; unidirectional
3	Parallel lines
4	Gross-hatch
5	Ignored

If such type of area fill is omitted, setting at type 1 is performed.
If the type of area fill is 1 or 2, spacing is performed at a PT command.

I M Input masks

Format : I M e ;

Description : Specifies the error mask value.
The mask value specified is the sum of any combination of the bit values shown in the following table. When a command error occurs, the bit in the mask corresponding to the error number as shown below is tested to determine if the errror bit (bit 5) of the status byte is to be set and the front panel ERROR LED is to be turned on. If a bit not set, there is no way to ever determine if that error occurred.

E-Mask Bit Value	Bit	Error Number	Meaning
1	0	1	Instruction not recognized
2	1	2	Wrong number of parameters
4	2	3	Bad parameter
8	3	4	Not used
16	4	5	Unknown character set
32	5	6	Position overflow
64	6	7	Not used
128	7	8	Not used

The default mask value of 223 (128 + 64 + 16 + 8 + 4 + 2 + 1) will specify that all errors except error 6 will set the error bit in the status byte and turn on the ERROR LED whenever they occur. Error 6 will not set the error bit or turn on the ERROR LED if it occurs, since it is not included in the mask value. Error 4.7 and 8 never occur so setting the mask to 151 will set the same conditions as the default value 223.

I N Initialize

Format : I N ;

Description : Sets the plotter to the initial state that is the same conditions as D F command, and added these conditions.

1. Setting for 0 degree (RO 0;) rotation of the axes.
2. Movement of the pen to the origin (0, 0). The pen is raised.
3. Clear-away of command error
4. Setting of the scaling points P1 and P2 at the initial values according to the paper size selected with DIP switches on the back side of the plotter.

IP Input P1 and P2

Format : IP P1x, P1y (, P2x, P2y) ; or IP;
Description : Specifies P1 and P2.
Parameters : If parameters are omitted, P1 and P2 are set to the default values according to paper size. If two parameters are used, (P1x, P1y) represents the position of P1 given in plotter units and P2 is so shifted as to keep P1 and P2 in fixed positional relation. If four parameters are used, (P1x, P1y) represent the position of P1, and (P2x, P2y) that of P2.

IW Input window

Format : IW XLL, YLL, XUR, YUR; or IW;
Description : Specifies a rectangular area called "window" in plotter units to set limits to movement of the pen.
Parameters : (XLL, YLL) is lower-left and (XUR, YUR) is upper-right corners of the window. Omitting parameters sets window to maximum plotting area, determined by the setting of the DIP switches.

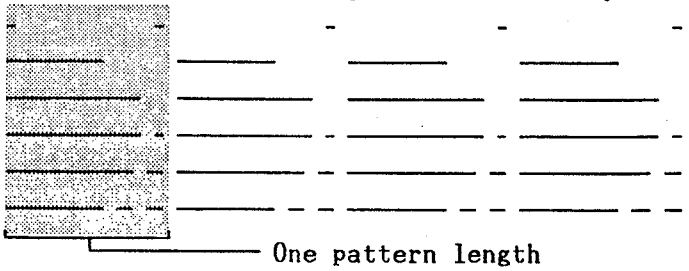
LB Print characters

Format : LB c . . . c t
Description : Draws a group of characters.
Character size is defined by an SI or SR command, direction of drawing by a DI or DR command, and inclination by an SL command.
Parameters : c...c — characters which may include control characters.
Terminator : t — label terminator defined by DT command. Default is ETX, decimal 3.

LT Designate line type and length

Format : LT t(, ℓ); or LT;
Description : Specifies the line type.
Parameters : t — 0 to +6. Omitting parameter causes solid line.

0- plots dots only at the points that are specified.



No parameter (Default Value)
ℓ — pattern length, 0 to 127.9999 ,a percentage of diagonal distance between P1 and P2. Default 4%.

OA Output of pen position

Format : OA ;
Output format : X, Y, P CR
P = 0 : Pen-up state
P = 1 : Pen-down state

Description : The OA command outputs the coordinates of the current pen position and indicates whether the pen is in up or down stae.

- The coordinate value should be within the current coordinate value range. It should also be represented in the plotter unit value at all times.
- Symbols, even if specified, will not be output except for "-" symbol.

OC Output of final pen position

Format : OC ;
Output format : X, Y, P CR
P = 0 : Pen-up state
P = 1 : Pen-down state

Description : The OC command outputs the X and Y coordinates which have been sent finally to the plotter and indicates whether the pen is in up or down state.

- The coordinate values will become either the plotter unit or user unit value according to the scaling.
- Symbol "-" can be output, but "+" will not be output.

OD Output of digitized point

Format : OD ;
Output format : X, Y, P CR

Description : The OD command outputs the X and Y coordinates of digitized point and indicates whether the pen is in up or down state.

- How to output X, Y, P is the same as with OC command.

OE Output of error No.

Format : OE ;
Output format : Error no. CR

Description : The OE command outputs the error no., and then releases the error.

- The error no. to be output will be one of those shown in IM command, which is represented by a positive decimal number.
- Once this command is accepted, then bit 5 of status value* will be cleared, and the error lamp goes off.

(Note *) Refer to the explanation of OS command.

OF Output of number of plotter units

Format : OF ;
Output format : 40, 40 CR

Description : The OF command outputs the number of plotter units located per mm.

- In the Model 672-XD the number of plotter units is fixed for each 0.025 mm, and thus the output value will remain unchanged at all times.

OH Output of coordinate range

Format : OH ;
Output format : X_{LL}, Y_{LL}, X_{UR}, Y_{UR} CR

Description : The OH command outputs the diagonal coordinate values of the lower left and upper right corners representing the current coordinate range through the plotter units.

- Each parameter should be specified by an integer.
- When the coordinate system is rotated as much as 90°, then the coordinate values of the lower left and upper right will also be changed.

OI Output of model name

Format : OI ;
Output format : 7475A CR (fixed)

Description : The OI command outputs the model name of the plotter currently being emulated.

OO Output of option

Format : OO ;
Output format : 0, 1, 0, 0, 1, 0, 0, 0 CR

Description : The OO command outputs the option built into the plotter.

- In the Model 672-XD, option output will remain at a constant value at all times.
  (The options are automatic pen exchange command, circle/arc drawing command.)

OP Output of scaling

Format : OP ;

Output format : P_1x, P_1y, P_2x, P_2y CR

Description : The OP command outputs the coordinate values of the current P1 and P2 through the plotter unit.

- Upon completion of the output, bit 1 of the status value will be cleared.

OS Output of status

Format : OS ;

Output format : s CR

s : Status value represented by an integer ranging from 0 to 255.

Description : The OS command outputs the status of the plotter with a decimal number.

Decimal Number	bit	Meaning
1	0	Pen-down
2	1	P1/P2 value has been changed (to be cleared by executing OP command).
4	2	Digitized point has become effective (to be cleared by executing OD command).
8	3	Initialization has been made (to be cleared by executing OS command)
16	4	There is an empty space in buffer.
32	5	An error has occurred (to be cleared by executing OE command).
64	6	0 at all times
128	7	0 at all times

- The status value will be set at 26 (2 + 8 + 16) at power ON. It will be changed to 16 after OS command is executed.

OW Output of window

Format : OW ;

Output format : X_{LL}, Y_{LL}, X_{UR}, Y_{UR} CR

Description : The OW command outputs the diagonal coordinates of the lower left (X_{LL}, Y_{LL}) and the upper right (X_{UR}, Y_{UR}) of the current window.

- All values will be output in a plotter unit.

PA Plot absolute

Format : PA X1, Y1 (, X2, Y2, ……) ;
or
PA ;

Description : Move the pen to the point specified at absolute coordinates (X1, Y1) using current pen up/down status.
If parameters are omitted, the plotter is set in the absolute plotting mode, and all the subsequent coordinate values are handled as absolute coordinates.

PD Pen down

Format : PD ;
or
PD X1, Y1 (, X2, Y2, ……) ;

Description : Programmatically lowers the pen. Parameters may be included as in PA or PR.

PR Plot relative

Format : PR X1, Y1 (, X2, Y2, ……) ;
or
PR ;

Description : Moves the pen to the points specified at relative coordinates (X1, Y1) using current pen up/down status.
If parameters are omitted, the plotter is set in the relative plotting mode, and all the subsequent coordinate values are handled as relative coordinates.

PS Paper size

Format : PS n ;
Description : Specifies the paper size.
Parameters : 0-3 or 4-127; 0-3 selects either B or A3 size paper; 4-127 selects A or A4 size paper.

PT Pen thickness

Format : PT t ;
or
PT ;

Description : Specifies the pen thickness in mm. The pen thickness is the line interval of an area fill when the fill type 1 or 2 is specified by a FT command.

Parameters : Decimal between 0.1 mm - 5.0 mm. If parameter is omitted, defaults to 0.3 mm size.
Set to 0.3 mm again if an SP command is executed.

PU Pen up

Format : PU ;
or
PU X1, Y1 (, X2, Y2……) ;

Description : Programmatically raises the pen. Parameters may be included as in PA or PR.

RA Shade rectangle absolute

Format : RA X, Y ;

Description : Shades or hatches a rectangle. The edge of the rectangle are not drawn.

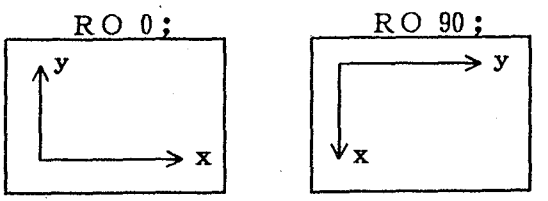
Parameters : (X, Y) are absolute coordinates representing the position of the corner diagonally opposite to the current position of the pen. The rectangle is formed by lines of the type specified by an LT command. The pen returns to the original position upon completion of the drawing .

RO Rotate coordinate system

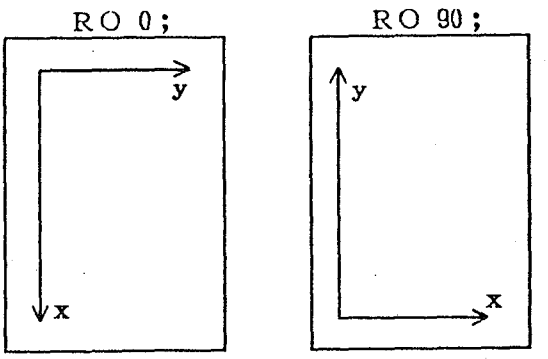
Format : RO 0 (or 90) ;
or
RO ;

Description : Rotates the coordinate system 90 degrees.

Parameters : 0 or no parameter: Not roatated. The x axis extends parallel to the longer sides of the paper.
90 : Rotated. The y axis extends parallel to the longer sides of the paper.



A/A4 size paper



B/A3 size paper

RR Shade rectangle relative

Format : RR ΔX, ΔY ;

Description : Shades or hatches a rectangle. The edge of the rectangle are not drawn.

Parameters : (ΔX, ΔY) are relative coordinates representing the position of the corner diagonally opposite to the current position of the pen. The rectangle is formed by lines of the type specified by an LT command. The pen returns to the original position upon completion of the drawing .

SA Select alternate character set

Format : SA ;
Description : Selects the alternate character set designated by the CA command to be used for all character plotting.

SC Scale

Format : SC Xmin, Xmax, Ymin, Ymax ; or SC ;
Description : If parameters are omitted, the plotter is set in the scale-off state. All the subsequent coordinate values sent to the plotter are handled as values in plotter units.
If parameters are provided, the plotter is set in the scale-on state. (Xmin, Ymin) are the coordinates of P1 in user units, and (Xmax, Ymax) the coordinates of P2 in user units.
If a command is properly executed, all the subseqent coordinate values sent to the plotter are handled as values in user units.

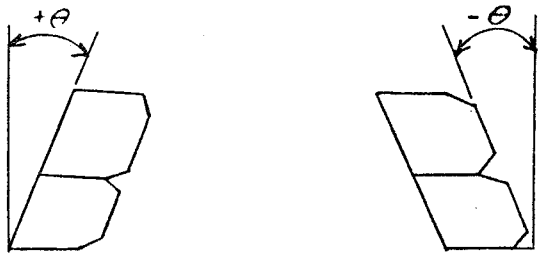
SI Absolute character size

Format : SI w, h; or SI ;
Description : Specifies the character width w, and height h, in cm .
Parameters : w, h — $\geqq$-128 and $<$128.
An SI command with no parameters will default to the following parameters based on the paper size:

Paper Size	Width	Height
A/A4	.177 cm	.255 cm
B/A3	.285 cm	.375 cm

SL Absolute character slant(from vertical)

Format : SL tan θ ; or SL ;
Description : Specifies the character slant.
Parameters : $\geqq$-128 and $<$128, interpreted as the tangent of the angle with vertical.
Omitting parameters establishes no slant, the same as the default or "SL 0;".



[SM] Symbol mode

Format : SM c ; or SM ;

Description : Defines the character c. The character c is written at the end of the vector specified by a PA, PR, PD or PU command, and that character is written around the current position of the pen. A character size, a degree of inclination and a direction of drawing can be specified with SI, SR, SL, DI and DR commands.
The specified character c remains unchanged even if the character set is changed by CS, CA, SS or SA command.

Parameters : Any printing character ASCII 33 through 126 excluding semicolon (ASCII 59). The character c can be canceled by providing space, a control character or a semicolon as a parameter.

[SP] Select pen

Format : SP n ; or SP ;

Description : Selects the pen specified by pen number n.

Parameters : $0 \leqq n \leqq 6$

n = 1, 5	Pen No. = 1
n = 2, 6	Pen No. = 2
n = 3	Pen No. = 3
n = 4	Pen No. = 4

If zero or no parameter is given, the plotter selects the No. 1 pen, but the rest of the drawing action is performed with the pen up.
If the parameter is outside the specified range, the command is disregarded, and the state of the pen remains unchanged.
"SPO ;" immediately after the power is turned ON.

[SR] Relative character size

Format : SR w, h ; or SR ;

Description : Specifies the character width and height relative to P1 and P2 positions.

Parameters : Decimals representing a percentage of vertical or horizontal distance between P1 and P2.
w — percentage of(P2x−P1x).
h — percentage of(P2y−P1y).
Omitting parameters results in value 0.75 for width and 1.5 for height.

[S S] Select standard character set

Format : S S ;
Description : Selects the standard character set designated by the CS command to be used for all character plotting.

[T L] Tick length

Format : T L tp(,tn); or T L ;
Description : Specifies the length of tick for use of X T and Y T command.
Parameters : -128 ≦ tp, tn ≦ 128
tp — percentage of (P2y−P1y) for X T or (P2x−P1x) for Y T. Denotes portion above the X-axis or to the right of the Y-axis when difference is positive.
tn — same as tp except denotes portion below the X-axis and to the left of the Y-axis. tn = 0 if tn is omitted.
Omitting parameters causes tick lengths tp and tn 0.5% of (P2y−P1y) or (P2x−P1x), the same as the default values.

[U C] User defined character

Format : U C p 1 , Δ X 1 , Δ Y 1 (, p 2 , Δ X 2 , Δ Y 2 ……) ;
Description : Draws characters or symbols defined by user.
Parameters : p (pen control) — ≧ +99 pen down or ≦ -99 pen up.
ΔX, ΔY — -99 <or < +99. Amount of movement from the current position in grid units.
Omitting parameters causes carriage return.
If using a maximum of 4 grid units in width direction and a maximum of 8 grid units in height direction, drawing can be made in the same size as the characters.

[V S] Select velocity v

Format : V S v ; or V S ;
Description : Specifies the pen velocity in cm/sec.
Parameters : v 0 to 10 : velocity is 12.5 cm/sec.
11 to 127.9999 : velocity is 20 cm/sec.

If no parameter is provided, the pen speed is set to 20 cm/sec.

WG Shade wedge

Format : WG r, s, a (, c) ;

Description : Shades or hatches a wedge.
The pen is currently positioned at the pivot of the wedge.
The pen returns to the original position upon completion of the drawing.

Parameter	Range	Default
r : radius	−32768.0000− +32767.9999	none
s : start angle	−32768	none
a : sweep angle	+32767(MOD 360)	
c : chord angle	1-120	5°

r − The sign of the radius defines the zero-degree reference point for the start angle and sweep angle.

s − a positive value positions the radius CCW from the zero-degree reference point; a negative value positions the radius CW from the zero-degree reference point.

a − a positive value draws the arc segment CCW; a negative value draws the arc segment CW.

c − defines arc smoothness in degrees.

XT X-axis tick

Format : XT ;

Description : Draws a vertical tick mark of the length specified by the TL command at the current pen position.
The mark is formed by solid lines regardless of whether the pen is up or down and regardless of the kind of line specified by an LT command.

YT Y-axis tick

Format : YT ;

Description : Draws a horizontal tick mark of the length specified by the TL command at the current pen position.
The mark is fromed by solid lines regardless of whether the pen is up or down and regardless of the kind of line specified by an LT command.

5.4 Device Control Command

The following commands are used for controling the communication status.
Each command must be in ESC code sequence and made up of 3 characters.

Table 5-1 shows the kind of commands.

- [ ] Indicates that the parameter enclosed with the brackets is option.
- ( ) Indicates that the parameter enclosed with the parenthesis is option.
- ; Indicates a delimiter to be placed between respective parameters. If ; is used with no parameter specified, standard value is set as a parameter.
- : Indicates the end of a command. A command without an accompanying parameter can be omitted.
- <dec> Indicates a parameter entered in decimal notation.
- <asc> Indicates a character code written in ASCII.

Table 5-1 Device Control Commands

Command	Function	Key-in Format	Description
ESC. (or ESC. Y	Plotter ON	ESC. (or ESC. Y	Puts the plotter in program ON status, and thereafter receives data to execute them as a plotter drawing command. ◦ In the Model 672-XD this command will be ignored since the plotter is always put in program ON status immediately after power ON.
ESC.) or ESC. Z	Plotter OFF	ESC.) or ESC. Z	Puts the plotter in program OFF status, and thereafter disables receiving data any more. ◦ In the Model 672-XD, this command will be ignored since the plotter is alway put in program ON status immediately after power ON.
ESC. @	Setting of handshake condition	ESC. @[(<dec>);(<dec>)]:	Sets logical buffer size, hardwire handshack mode.
		1st <dec> : Sets a logical buffer size within a range of 0 to 512.	

<table>
<tr><th>Command</th><th>Function</th><th>Key-in Format</th><th>Description</th></tr>
<tr><td></td><td></td><td>If the specified buffer size value is 513 or more, it is assumed to be 512.
2nd <dec> : A decimal number of 0 to 127
<table>
<tr><th>Status
Bit No.</th><th>0</th><th>1</th></tr>
<tr><td>0</td><td>Hardwire handshake disable</td><td>Hardwire handshake enable</td></tr>
<tr><td>1</td><td colspan="2">Not used</td></tr>
<tr><td>2</td><td colspan="2">Not used</td></tr>
<tr><td>3</td><td colspan="2">Not used</td></tr>
<tr><td>4</td><td colspan="2">Not used</td></tr>
</table></td><td>◦ When this commad is input in the initial value status or without specifying parameters, the buffer size will be set to 512 bytes, and hardwire handshake will remain unchanged.
◦ The 2nd parameter will remain unchanged from the already set value if there is any.</td></tr>
<tr><td>ESC. B</td><td>Output of remaining buffer capacity</td><td>ESC. B

Output format : <dec> CR</td><td>Outputs the remaining capacity of buffer in reference to the logical buffer size for software handshake.</td></tr>
<tr><td>ESC. E</td><td>Output of error no.</td><td>ESC. E
Output format : <dec> CR
<dec> : Error no.
<table>
<tr><th>Error No.</th><th>Error Meaning</th></tr>
<tr><td>0</td><td>There is no I/O error.</td></tr>
<tr><td>10</td><td>Another output command has been received while an output command is being executed.</td></tr>
<tr><td>11</td><td>Invalid data is received after "ESC."</td></tr>
<tr><td>12</td><td>Invalid data has been found in device control command. The data following the invalid one will be set to the initial value.</td></tr>
</table></td><td>Outputs the error status related to RS-232-C, and puts off the ERROR lamp on the control panel.</td></tr>
</table>

<table>
<tr><th>Command</th><th>Function</th><th>Key-in Format</th><th>Description</th></tr>
<tr><td></td><td></td><td colspan="2">
<table>
<tr><th>Error No.</th><th>Error Meaning</th></tr>
<tr><td>13</td><td>Parameter is not within the allowable range.</td></tr>
<tr><td>14</td><td>The number of parameters is excessive.
The excessive parameter(s) will be ignored.</td></tr>
<tr><td>15</td><td>Communication error (framing, parity, over-run)</td></tr>
<tr><td>16</td><td>Buffer overflow</td></tr>
</table>
</td></tr>
<tr><td>ESC. H</td><td>Setting of handshake mode 1</td><td>ESC. H[(<dec>);(<asc>);
(<asc>(; <asc>;...
<asc>))]:</td><td>Prescribes the protcol of ENQ/ACK handshake or Xon-Xoff handshake (mode 1). The parameter descriptions are the same for both instrutions and are given under the ESC. I instruction.</td></tr>
<tr><td>ESC. I</td><td>Setting of handshake mode 2</td><td>ESC. I[(<dec>;(<asc>);
(<asc>(; <asc>;...
<asc>))]:</td><td>Prescribes the protocol of ENQ/ACK handshake or Xon-Xoff handshake (mode 2).</td></tr>
<tr><td></td><td></td><td colspan="2">Xon-Xoff handshake parameters
<dec> : Sets the Xoff threshold level with number of empty buffer bytes.
Xon threshold level will be set automatically to 256 bytes.
If Xoff threshold level is specified in excess of 256 bytes, Xon threshold level will be set to Xoff level plus 1.
<asc> : This parameter may be omitted with either ; or 0; specified.
<asc>;..<asc> : 1 to 10 Xon trigger characters represented by 0 to 127 written in ASCII code.
Note that 0, if specified, is regarded as an end of character string.
Generally, 17 (DC1) used.
ENQ/ACK handshake parameters
<dec> : Data block size ranging from 0 to 32767.
<asc> : ENQ character ranging from 0 to 126 to be</td></tr>
</table>

(cont'd)

<table>
<tr><th>Command</th><th>Function</th><th>Key-in Format</th><th>Description</th></tr>
<tr><td></td><td></td><td></td><td>specified in ASCII code.
Generally, the parameter should be specified as 5 (ENQ).
<asc>...<asc> : 1 to 10 ACK characters represented by 0 to 127 in ASCII code.
Generally, the parameter should be specified as 6 (ACK).
: In the initial value status, both Xon-Xoff handshake and ENQ/ACK handshake will be disabled, and data block size will be set to 80 bytes with no output character.
: When ENQ (5 in ASCII code) is sent from the computer, the plotter will respond with ACK (6 in ASCII code) even if ENQ and ACK characters are not defined.
Note that this is a dummy handshake, and thus the buffer will not be controlled.

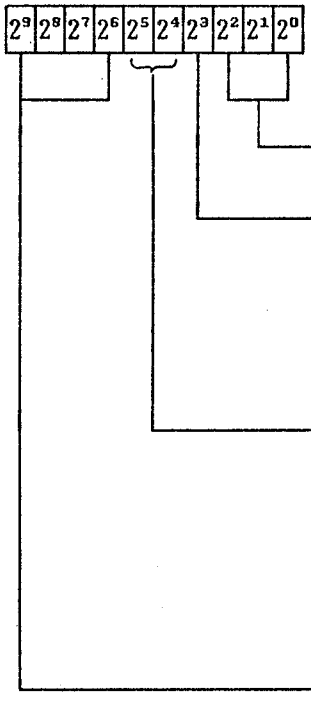
Handshake parameters are defined as shown in the next table.
<table>
<tr><th>ESC. M/ESC. N Parameter</th><th>mode 1</th><th>mode 2</th><th>Output Command</th></tr>
<tr><td>Turn-around delay</td><td>YES</td><td>YES</td><td>YES</td></tr>
<tr><td>Output trigger character</td><td>YES</td><td>NO</td><td>YES</td></tr>
<tr><td>Output terminator</td><td>YES</td><td>NO</td><td>YES</td></tr>
<tr><td>Output initiator</td><td>NO</td><td>NO</td><td>YES</td></tr>
<tr><td>Character delay</td><td>YES</td><td>YES</td><td>YES</td></tr>
</table>
</td></tr>
<tr><td>ESC. L</td><td>Output of buffer size</td><td>ESC. L

Output format : <dec> CR</td><td>Outputs the size of logical buffer set by ESC. @ after the buffer is emptied.
The computer will determine the</td></tr>
</table>

Command	Function	Key-in Format	Description
			handshake parameters in accordance with the data which have been output.
ESC. M	Setting of handshake parameter	ESC. M[(<dec>);(<asc>);(<asc>);(<asc>(;<asc>);(<asc>)]:	Sets handshake parameters. ◦ In case of the initial value or when no parameter is specified, turn-around is set to 0, there is no output trigger character nor output terminator is set to $0D (CR), and there is no output initiator.
		<dec> : Turn-around delay represented by 0 to 32767 (milliseconds). <asc> : Output trigger character represented by a decimal number ranging from 0 to 126. <asc> : Ignored <asc>;<asc> : Output terminator specified with a decimal code ranging from 0 to 127. It should consist of either 1 or 2 characters. If it is specified with 1 character, it should be followed by ;;. <asc> : Output initiator represented by a decimal code ranging from 0 to 127.	
ESC. N	Setting of handshake parameter	ESC. N[(<dec>);(<asc>(;...<asc>))]:	Sets Xon-Xoff or ENQ/ACK handshake parameter. ◦ IN case of the initial value or when no parameter is specified, character-to-character delay is set to 0, and there is no Xoff trigger character nor immediate response character.
		<dec> : Character-to-character delay represented by 0 to 32767 (msec). <asc>;...<asc>: 1 to 10 characters represented by decimal numbers ranging from 0 to 127. (1) In case of Xon-Xoff handshake, these	

(cont'd)

Command	Function	Key-in Format	Description
			are used to specify a trigger character. Generally, 19 (DC3) used. (2) In case of ENQ/ACK handshake, these are used to specify an immediate response character.
ESC. O	Output of plotter status	ESC. O Output format : <dec> CR <dec> : Decimal number ranging from 0 to 512	Outputs the current plotter status.
ESC. R	Resetting of handshak parameter	ESC. R	Resets handshake parameter. This command sequence is equivalent to the following one. ESC. @ : ESC. N : ESC. I : ESC. M :


2^9 2^8 2^7 2^6 2^5 2^4 2^3 2^2 2^1 2^0
Zero at all times
0 : Indicates that buffer is not empty.
1 : Indicates that buffer is empty, and thus data can be received.
(0, 0) : Indicates that command is under execution.
(0, 1) : Indicates that the plotter is in VIEW status with paper already set.
2^6 to 2^9 not used (0 at all times)

5. 5 Input Data Code

Input data signals of the plotter are based on the character code listed in Table 5-2. One of the character sets is selected by command CA or CS.

Table 5-2 Character Set Definitions

Set No.	Description	ISO Registration Number
Set 0	ANSI ASCII	006
Set 1	9825 Character Set	—
Set 2	French/German	—
Set 3	Scandinavian	—
Set 4	Spanish/Latin America	—
Set 6	JIS ASCII	014
Set 7	Roman 8 Extensions	—
Set 8	Katakana	013
Set 9	ISO IRV (International Reference Version)	002
Set 30	ISO Swedish	010
Set 31	ISO Swedish For Names	011
Set 32	ISO Norway,Version 1	060
Set 33	ISO German	021
Set 34	ISO French	025
Set 35	ISO United Kingdom	004
Set 36	ISO Italian	015
Set 37	ISO Spanish	017
Set 38	ISO Portuguese	016
Set 39	ISO Norway,Version 2	061

Table 5-3 Character Definitions

Decimal Value	ASCII Character	All Sets
0	NULL	No Operation (NOP)
1	SOH	NOP
2	STX	NOP
3	ETX	End LB Command
4	ETO	NOP
5	ENQ	NOP
6	ACK	NOP
7	BEL	NOP
8	BS	Backspace
9	HT	Horizontal Tab (1/2 backspace)
10	LF	Line Feed
11	VT	Inverse Line Feed
12	FF	NOP
13	CR	Carriage Return
14	SO	Select Alternate Character Set
15	SI	Select Standard Character Set.
16	DLE	NOP
17	DC1	NOP
18	DC2	NOP
19	DC3	NOP
20	DC4	NOP
21	NAK	NOP
22	SYN	NOP
23	ETB	NOP
24	CAN	NOP
25	EM	NOP
26	SUB	NOP
27	ESC	NOP
28	FS	NOP
29	GS	NOP
30	RS	NOP
31	US	NOP
32	SP	Space

NOTE: Characters within a rectangle have the automatic backspace feature.

Table 5-3 Character Definitions

DECIMAL VALUE	SET																		
	0	1	2	3	4	6	7	8	9	30	31	32	33	34	35	36	37	38	39
32																			
33	!	!	!	!	!	!	À	◆	!	!	!	!	!	!	!	!	!	!	!
34	"	"	"	"	"	"	Â	｢	"	"	"	"	"	"	"	"	"	"	"
35	#	#	£	£	¿	#	È	｣	#	#	#	#	#	£	£	£	£	#	§
36	$	$	$	$	$	$	Ê	、	¤	¤	¤	$	$	$	$	$	$	$	$
37	%	%	%	%	%	%	Ë	・	%	%	%	%	%	%	%	%	%	%	%
38	&	&	&	&	&	&	Î	ヲ	&	&	&	&	&	&	&	&	&	&	&
39	'	'	'	'	'	'	Ï	ｧ	'	'	'	'	'	'	'	'	'	'	'
40	(	(	(	(	(	(	´	ｨ	(	(	(	(	(	(	(	(	(	(	(
41	)	)	)	)	)	)	˜	ｩ	)	)	)	)	)	)	)	)	)	)	)
42	*	*	*	*	*	*	ˆ	ｪ	*	*	*	*	*	*	*	*	*	*	*
43	+	+	+	+	+	+	¨	ｫ	+	+	+	+	+	+	+	+	+	+	+
44	,	,	,	,	,	,	¸	ｬ	,	,	,	,	,	,	,	,	,	,	,
45	−	−	−	−	−	−	Ù	ｭ	−	−	−	−	−	−	−	−	−	−	−
46	.	.	.	.	.	.	Û	ｮ	.	.	.	.	.	.	.	.	.	.	.
47	/	/	/	/	/	/	£	ｯ	/	/	/	/	/	/	/	/	/	/	/
48	0	0	0	0	0	0	¯	ｰ	0	0	0	0	0	0	0	0	0	0	0
49	1	1	1	1	1	1		ｱ	1	1	1	1	1	1	1	1	1	1	1
50	2	2	2	2	2	2		ｲ	2	2	2	2	2	2	2	2	2	2	2
51	3	3	3	3	3	3	˙	ｳ	3	3	3	3	3	3	3	3	3	3	3
52	4	4	4	4	4	4	Ç	ｴ	4	4	4	4	4	4	4	4	4	4	4
53	5	5	5	5	5	5	ç	ｵ	5	5	5	5	5	5	5	5	5	5	5
54	6	6	6	6	6	6	Ñ	ｶ	6	6	6	6	6	6	6	6	6	6	6
55	7	7	7	7	7	7	ñ	ｷ	7	7	7	7	7	7	7	7	7	7	7
56	8	8	8	8	8	8	¡	ｸ	8	8	8	8	8	8	8	8	8	8	8
57	9	9	9	9	9	9	¿	ｹ	9	9	9	9	9	9	9	9	9	9	9
58	:	:	:	:	:	:	¤	ｺ	:	:	:	:	:	:	:	:	:	:	:
59	;	;	;	;	;	;	£	ｻ	;	;	;	;	;	;	;	;	;	;	;
60	<	<	<	<	<	<	¥	ｼ	<	<	<	<	<	<	<	<	<	<	<
61	=	=	=	=	=	=	§	ｽ	=	=	=	=	=	=	=	=	=	=	=
62	>	>	>	>	>	>	ƒ	ｾ	>	>	>	>	>	>	>	>	>	>	>
63	?	?	?	?	?	?	¢	ｿ	?	?	?	?	?	?	?	?	?	?	?

Table 5-3 Character Definitions (continued)

DECIMAL VALUE	SET																		
	0	1	2	3	4	6	7	8	9	30	31	32	33	34	35	36	37	38	39
64	@	@	@	@	@	@	â	タ	@	@	É	@	§	à	@	§	§	§	@
65	A	A	A	A	A	A	ê	チ	A	A	A	A	A	A	A	A	A	A	A
66	B	B	B	B	B	B	ô	ツ	B	B	B	B	B	B	B	B	B	B	B
67	C	C	C	C	C	C	û	テ	C	C	C	C	C	C	C	C	C	C	C
68	D	D	D	D	D	D	á	ト	D	D	D	D	D	D	D	D	D	D	D
69	E	E	E	E	E	E	é	ナ	E	E	E	E	E	E	E	E	E	E	E
70	F	F	F	F	F	F	ó	ニ	F	F	F	F	F	F	F	F	F	F	F
71	G	G	G	G	G	G	ú	ヌ	G	G	G	G	G	G	G	G	G	G	G
72	H	H	H	H	H	H	à	ネ	H	H	H	H	H	H	H	H	H	H	H
73	I	I	I	I	I	I	è	ノ	I	I	I	I	I	I	I	I	I	I	I
74	J	J	J	J	J	J	ò	ハ	J	J	J	J	J	J	J	J	J	J	J
75	K	K	K	K	K	K	ù	ヒ	K	K	K	K	K	K	K	K	K	K	K
76	L	L	L	L	L	L	ä	フ	L	L	L	L	L	L	L	L	L	L	L
77	M	M	M	M	M	M	ë	ヘ	M	M	M	M	M	M	M	M	M	M	M
78	N	N	N	N	N	N	ö	ホ	N	N	N	N	N	N	N	N	N	N	N
79	O	O	O	O	O	O	ü	マ	O	O	O	O	O	O	O	O	O	O	O
80	P	P	P	P	P	P	Å	ミ	P	P	P	P	P	P	P	P	P	P	P
81	Q	Q	Q	Q	Q	Q	î	ム	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q	Q
82	R	R	R	R	R	R	Ø	メ	R	R	R	R	R	R	R	R	R	R	R
83	S	S	S	S	S	S	Æ	モ	S	S	S	S	S	S	S	S	S	S	S
84	T	T	T	T	T	T	å	ヤ	T	T	T	T	T	T	T	T	T	T	T
85	U	U	U	U	U	U	í	ユ	U	U	U	U	U	U	U	U	U	U	U
86	V	V	V	V	V	V	ø	ヨ	V	V	V	V	V	V	V	V	V	V	V
87	W	W	W	W	W	W	æ	ラ	W	W	W	W	W	W	W	W	W	W	W
88	X	X	X	X	X	X	Ä	リ	X	X	X	X	X	X	X	X	X	X	X
89	Y	Y	Y	Y	Y	Y	ì	ル	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y	Y
90	Z	Z	Z	Z	Z	Z	Ö	レ	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z	Z
91	[	[	[	Ø	[	[	Ü	ロ	[	Ä	Ä	Æ	Ä	•	[	•	¡	Ã	Æ
92	\	ſ	ç	Æ	¡	¥	É	ワ	\	Ö	Ö	Ø	Ö	ç	\	ç	Ñ	Ç	Ø
93	]	]	]	ø	]	]	ï	ン	]	Å	Å	Å	Ü	§	]	é	¿	Õ	Å
94	^	↑	^	æ	^	^	ß	゜	^	^	Ü	^	^	^	^	^	^	^	^
95	_	_	_	_	_	_	Ô	•	_	_	_	_	_	_	_	_	_	_	_

Table 5-3 Character Definitions (continued)

DECIMAL VALUE	SET 0	1	2	3	4	6	7	8	9	30	31	32	33	34	35	36	37	38	39
96	`			`	`	`	Á		`	`	é	`	`	`	`	ù	`	`	`
97	a	a	a	a	a	a	Ã		a	a	a	a	a	a	a	a	a	a	a
98	b	b	b	b	b	b	ã		b	b	b	b	b	b	b	b	b	b	b
99	c	c	c	c	c	c	Đ		c	c	c	c	c	c	c	c	c	c	c
100	d	d	d	d	d	d	đ		d	d	d	d	d	d	d	d	d	d	d
101	e	e	e	e	e	e	Í		e	e	e	e	e	e	e	e	e	e	e
102	f	f	f	f	f	f	Ì		f	f	f	f	f	f	f	f	f	f	f
103	g	g	g	g	g	g	Ó		g	g	g	g	g	g	g	g	g	g	g
104	h	h	h	h	h	h	Ò		h	h	h	h	h	h	h	h	h	h	h
105	i	i	i	i	i	i	Õ		i	i	i	i	i	i	i	i	i	i	i
106	j	j	j	j	j	j	õ		j	j	j	j	j	j	j	j	j	j	j
107	k	k	k	k	k	k	S̃		k	k	k	k	k	k	k	k	k	k	k
108	l	l	l	l	l	l	s̃		l	l	l	l	l	l	l	l	l	l	l
109	m	m	m	m	m	m	Ú		m	m	m	m	m	m	m	m	m	m	m
110	n	n	n	n	n	n	Ÿ		n	n	n	n	n	n	n	n	n	n	n
111	o	o	o	o	o	o	ÿ		o	o	o	o	o	o	o	o	o	o	o
112	p	p	p	p	p	p	Ì		p	p	p	p	p	p	p	p	p	p	p
113	q	q	q	q	q	q	þ		q	q	q	q	q	q	q	q	q	q	q
114	r	r	r	r	r	r			r	r	r	r	r	r	r	r	r	r	r
115	s	s	s	s	s	s			s	s	s	s	s	s	s	s	s	s	s
116	t	t	t	t	t	t			t	t	t	t	t	t	t	t	t	t	t
117	u	u	u	u	u	u			u	u	u	u	u	u	u	u	u	u	u
118	v	v	v	v	v	v	¯		v	v	v	v	v	v	v	v	v	v	v
119	w	w	w	w	w	w	¼		w	w	w	w	w	w	w	w	w	w	w
120	x	x	x	x	x	x	½		x	x	x	x	x	x	x	x	x	x	x
121	y	y	y	y	y	y	¤		y	y	y	y	y	y	y	y	y	y	y
122	z	z	z	z	z	z	º		z	z	z	z	z	z	z	z	z	z	z
123	{					{	«		{	ä	ä	æ	ä	é	{	à		ã	æ
124	|					|	¤		|	ö	ö	ø	ö	ù	|	ò	ñ	ç	ø
125	}	→				}	»		}	å	å	å	ü	è	}	è	ç	õ	å
126	~		'	•		~	±				ü		ß	¨		ì		•	|
127																			

6. ERROR ACTION

6.1 Error Caused by Input Mistake

(1) The error condition is as follows.

(a) Command not recognized : the plotter has received an illegal character sequence.

(ex.) A Q ; , P P; etc.

(b) Wrong number of parameters : too many or too few parameters have been sent with a command.

(ex.) S I 1.5, 1.5, 10;, P A 10; etc.

(c) Out-of-range parameters : received parameters are beyond the range described in chapter 5.3.

If no parameter range is given, the range is -2^{15} to $2^{15}-1$.

(ex.) S R 128.0000, 128.0000 ;
P A 32768, -32769 ; etc.

(d) Unknown character set : A character set out of the range 0-4, 6-9, 30-39 has been designated.

(e) Position overflow : see the next section.

When the error condition occurs, the error lamp provided on the control panel goes on. Then the plotter receives the next command and continues drawing while the error lamp is on.

(2) Error cancel

"I N" and "O E" commands cancel the error condition and turn off the error lamp.

NOTE : But when the pen is out of the window area, the error lamp remains on.

6.2 Error Caused by Off-scale of pen

Out-of-range parameters are ignored, whereby the pen state does not change, and the error condition occurs (parameter out of range). When scaling is off, effective parameters are within the range of -32768 and 32767. When scaling is on, both the parameters and plotter unit equivalent must be in the same range.

The plotter keeps on drawing when a coordinate value is inside the effective parameter area (-32768 ~ +32767 = plotter unit) even if the error lamp goes on. The pen, however, does not move outside the window area, and the plotter waits for the next command with the pen up.
Take Fig. 6-1 for instance.
In Fig. 6-1 the window area is specified as follows : (XLL, YLL)=(0, 0) and (XUR, YUR)=(4000, 4000). When the plotter receives "PA3000, 5000;", it draws a straight line from the present pen position (3000, 3000) to (3000, 4000), then the pen rises and the error lamp goes on, which indicates the pen is out of the window area. Next, when receiving "PA5000, 5000, 5000, 3000;", the pen position does not change and the error lamp is still on; because both the points (5000, 5000) and (5000, 3000) are out of the window area. Next, when receiving "PA3000, 3000;", the pen moves to the point (4000, 3000) with the pen up, the error lamp goes off, and the plotter draws a straight line from (4000, 3000) to (3000, 3000).

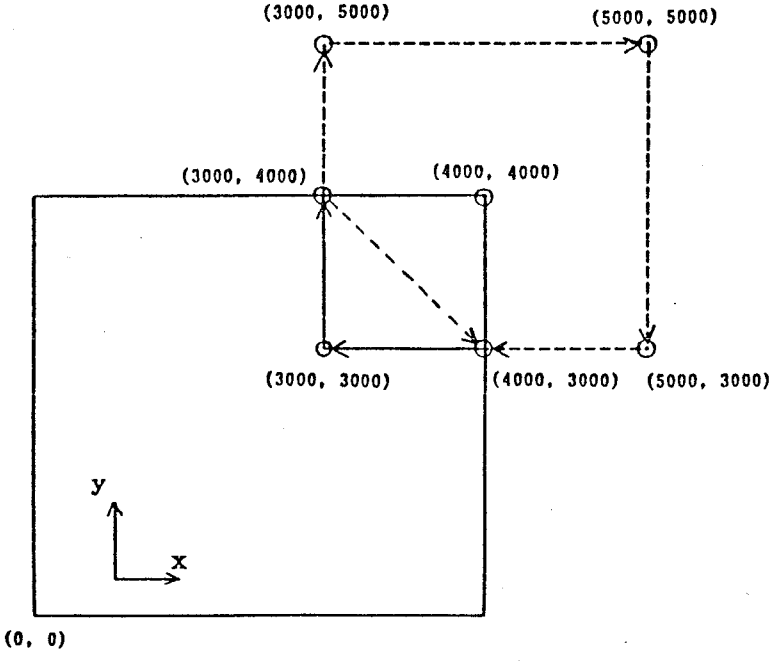


Fig. 6-1 Window Area

7. SPECIFICATIONS

System	:	Friction roller drive type (Paper moves in X-axis direction)
Chart	:	Ordinary paper or transparency film (ISO A3/A4, ANSI A/B size)
Effective plotting area	:	380 (X) × 270 (Y) mm
Pen type	:	Fiber-tip pen, Ceramic pen
Pen number	:	4 (Color ··· Black, red, blue, green)
Plotting speed	:	Max. 200 mm/s in axial direction Acceleration 1G
Character writing	:	Approx. 5 cps
Step size	:	0.025 mm
Distance accuracy	:	±0.4 % of shift distance ±0.2 mm
Repetition accuracy	:	0.3 mm
Accuracy of pen exchange	:	0.4 mm
Control keys	:	POSITION, PEN U/D, ENTER, PAPER SET, P1, P2, PAUSE, CHECK, and SHIFT
Indicator	:	POWER (green LED), ERROR (red LED)
Interface	:	8-bit parallel and RS-232-C serial interface (RS-232-C : Hardwire, Xon-Xoff, ENQ-ACK, and software-controlled handshaking.)
Buffer memory	:	512 bytes
Power requirement	:	120V, 220V or 240V AC 50/60 Hz
Dimensions	:	474 (W) × 219 (D) × 135 (H) mm
Weight	:	Approx. 6 kg

8. APPENDIX

8.1 Input/Output Interface

8.1.1 8-bit Parallel Interface

This plotter utilizes an 8-bit parallel interface which is based on the Centronics specifications. Parallel interface connector is provided on the rear side(Fig. 3-1). Pin arrangement and terminals are as shown in Fig. 8-1 and Table 8-1. Be sure to secure clamps on both sides after inserting the connector.

Fig. 8-1 Pin Arrangement in Parallel Interface Connector

(1) Parallel Interface Connector

Adaptive connector	:	36 pin type 57L-40360-2700(D5)(DDK, AMPHENOL) or equivalent
Lock	:	Bail Lock type

(2) Specifications

(a) Synchronization: By externally supplied $\overline{\text{STROBE}}$ pulses.
(b) Handshaking: $\overline{\text{ACKNLG}}$ or BUSY signals.
(c) Logic level: Input data and all interface control signals are compatible with the TTL level.

Table 8-1 Pin Assignment

Signal Pin No.	Return Pin No.	Signal	Direction	Description
1	19	$\overline{\text{STROBE}}$	In	STROBE pulse to read data in. Pulse width must be more than 0.5μs at receiving terminal. The signal level is normally "HIGH"; read-in of data is performed at the "LOW" level of this signal.
2	20	DATA 1	In	These signals represent information of the 1st to 8th bits of parallel data respectively. Each signal is at "HIGH" level when data is logical "1" and "LOW" when logical "0".
3	21	DATA 2	In	
4	22	DATA 3	In	
5	23	DATA 4	In	
6	24	DATA 5	In	
7	25	DATA 6	In	
8	26	DATA 7	In	
9	27	DATA 8	In	
10	28	$\overline{\text{ACKNLG}}$	Out	Approx. 5μs pulse. "LOW" indicates that data has been received and that the plotter is ready to accept other data.
11	29	BUSY	Out	A "HIGH" signal indicates that the plotter cannot receive data. The signal becomes "High" in the following cases: 1. During data entry 2. During plotting operation. 3. During plotter error status.
12	30	GND	Out	Logic GND level.
13	—	+5V	Out	Pulled up to +5V through 10 KΩ resistance.
14	—	NC	—	Not used.
15	—	NC		Not used.
16	—	GND		Logic GND level.

(cont'd)

Signal Pin No.	Return Pin No.	Signal	Direction	Description
17	—	CHASSIS GND	—	Plotter chassis GND. In the plotter, the chassis GND and the logic GND are isolated from each other.
18	—	NC	—	Not used.
19–30	—	GND	—	TWISTED-PAIR RETURN signal GND level.
31	—	NC	—	Not used.
32	—	+5V	Out	Pulled up to +5V through 10 KΩ resistance.
33	—	GND	—	Same as with Pin No. 19 to 30.
34	—	NC	—	Not used.
35			Out	Pulled up to +5V through 10 KΩ resistance.
36	—	NC	—	Not used.

NOTES 1: "Direction" refers to the direction of signal flow as viewed from the plotter.

2: "Return" denotes "TWISTED PAIR RETURN" and is to be connected at signal ground level.
As to the wiring for the interface, be sure to use a twisted-pair cable for each signal and never fail to complete connection on the Return side. To prevent noise effectively, these cables should be shielded and connected to the chassis of the System Unit and the plotter respectively.

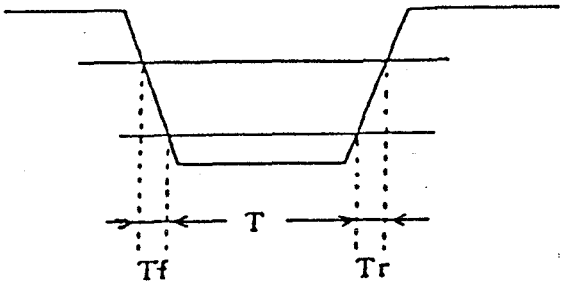
3: All interface conditions are based on TTL level. Both the rise and fall times of each signal must be less than 0.2μs.

4: Data transfer must not be carried out by ignoring the $\overline{\text{ACKNLG}}$ or BUSY signal. (Data transfer to this plotter can be carried out only after confirming the $\overline{\text{ACKNLG}}$ signal or when the level of the BUSY signal is "LOW".)

(3) Electrical conditions

(a) Signal levels

All input/output signals are TTL level.
"HIGH" level +2.4 ~ 5.0 V
"LOW" level +0.0 ~ 0.4 V (for the input pins on the printer)



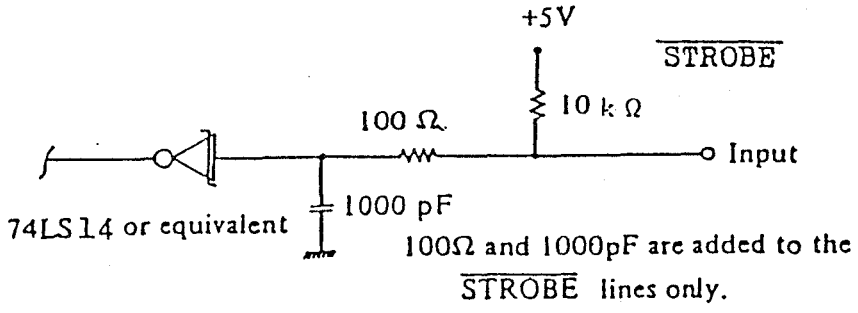
Tf, Tr = 0.2 μs or less
T is the value as shown in the timing chart.

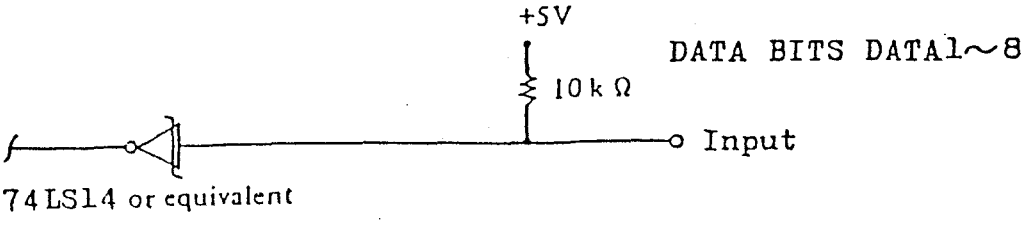
(b) Input/output conditions

Except for the $\overline{\text{STROBE}}$ signal, all input/output signals are pulled up to +5V through a 10 kΩ resistor.

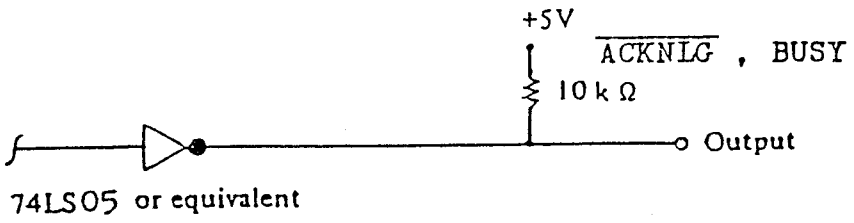
- **Input signals**
  Input loading is a 74LS14 or equivalent.
- **Output signals**
  Outputs are through a 74LS05 or equivalent. Recommended loading is one TTL or LSTTL or the equivalent.

Receiver





Driver

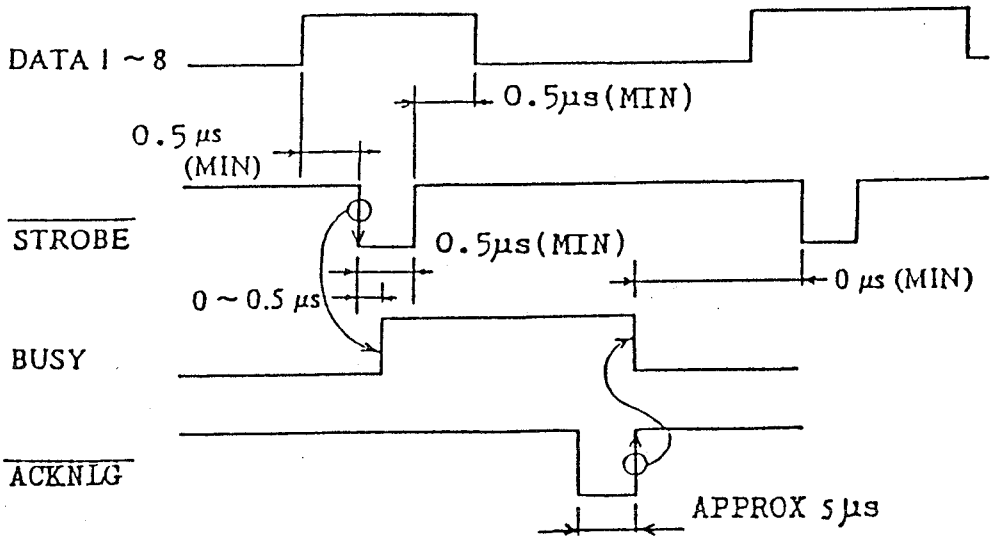


(c) Signal cable length

The maximum length is 2 meters and the following signals should be run as twisted pairs with the GND lines.

$\overline{\text{STROBE}}$, BUSY, $\overline{\text{ACKNLG}}$

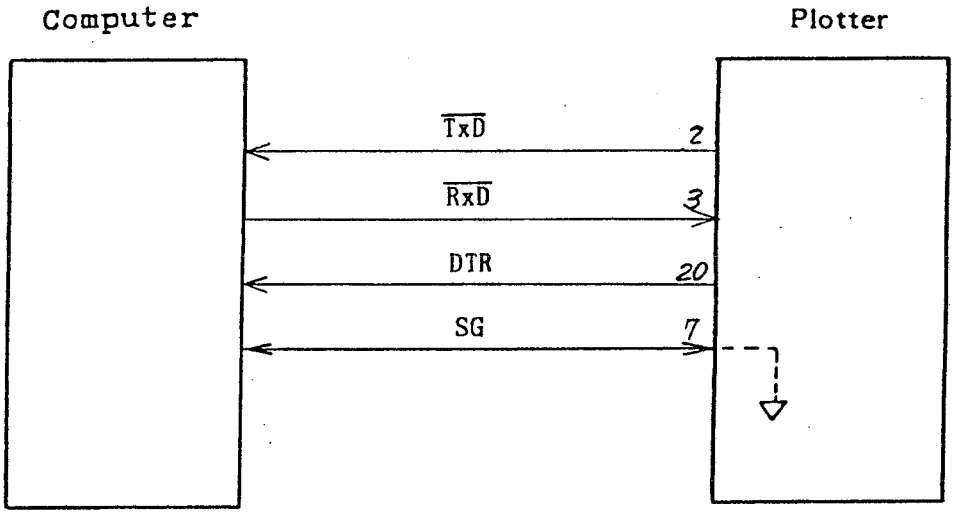
(d) Timing chart



8.1.2 RS-232-C Serial Interface

(1) Transmission Method

(a) Block diagram



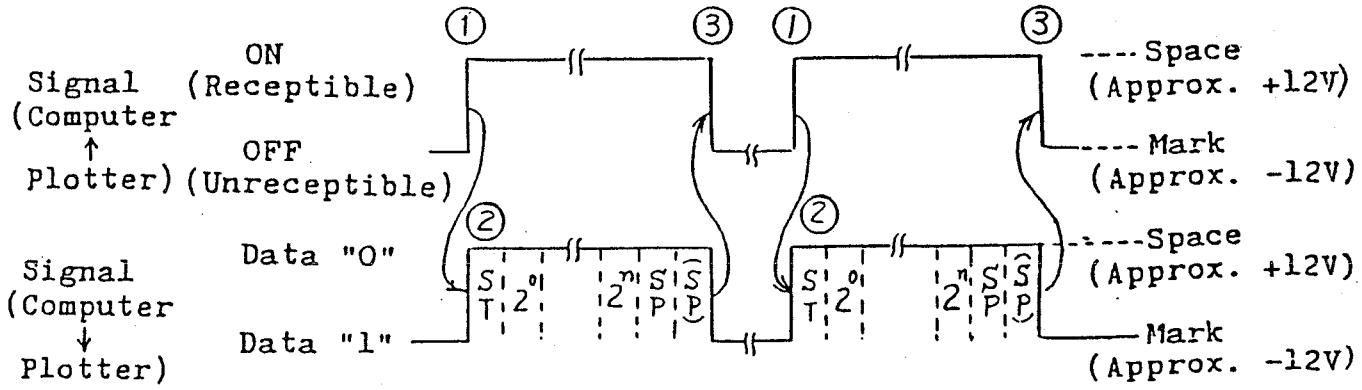
$\overline{TxD}$: Transferring data

$\overline{RxD}$: Receiving data

DTR : Data terminal ready

SG : Signal ground

(b) Procedure



Timing diagram

① As soon as data is receptible, the plotter turns DTR-signal to ON, and transmits it to computer.

② After confirming that DTR-signal is ON, through $\overline{RxD}$ line the computer transmits command signal and data signal to operate the plotter.

③ At each reception of one character $\overline{RxD}$-signal, the plotter turns DTR-signal to OFF.

(2) Transmission conditions

(a) Mode : Asynchronous serial data communication (Start bit/stop bit inserted)

(b) Baud rate : 300, 600, 1200, 2400, 4800, 9600. bauds

(c) Data format:

Start bit	1
Data bit	7 or 8
Parity bit	Odd, Even, or None
Stop bit	1 or 2

(Note) Transmission conditions are selected by DIP switched on the rear lower part of the plotter (See 4.9).

(3) Electric Characteristics

Input/output level

(a) Receiving data ($\overline{RxD}$)

Signal	Input level	Remarks
1 (mark)	-4～-12 V	Logical "1"
0 (space)	+4～+12 V	Logical "0"

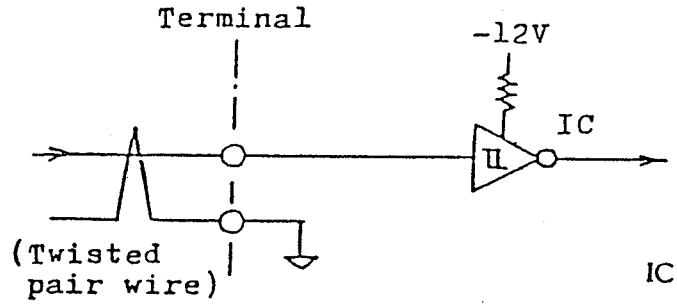
(b) Data terminal ready (DTR)

Signal	Input level	Remarks
ON	(typ) +6～+12 V	Plotter is in receptible condition.
OFF	(typ) -6～-12 V	Plotter is in unreceptible condition.

(Note) Load resistance: 3～7 kΩ

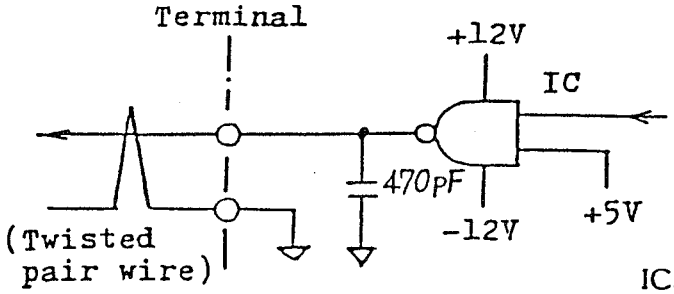
Input/output circuit

(a) Input ------- Signal $\overline{RxD}$



IC: Equivalent to 75189

(b) Output ------ Siganl DTR and $\overline{TxD}$



IC: Equivalent to 75188

(4) Pin Assignment

Signal direction (Computer⟷plotter)	Signal name	Signal pin		Signal name	Signal direction (Computer⟷plotter)
⟷	FG(*)	1	2	$\overline{TxD}$	←
←	$\overline{RxD}$	3	4	+12V	←
	NC	5	6	NC	
⟷	SG	7	8	NC	
	NC	9	10	NC	
	NC	11	12	NC	
	NC	13	14	NC	
	NC	15	16	NC	
	NC	17	18	NC	
	NC	17	20	DTR	←
	NC	21	22	NC	
	NC	23	24	NC	
	NC	25			

(Note) (*): Chassis grounded

Adaptive connector: Plotter end ····· DB-25S or equivalent
Cable end ····· DB-25P or equivalent

8. 2 Application Examples

Table 8-1 and Fig.8-1 , Table 8-2 and Fig.8-2 show examples of sample drawing program and drawing.

Table 8-1 Example of Drawing Program (Bar Graph)

```
10 '
20 '   BAR GRAPH EXAMPLE
30 '
40 OPEN"COM1:4800,N,8,2,CS65535,DS65535" AS #1
50 '   INITIAL SETTING
60 PRINT#1,"IN;"
70 PRINT#1,"IP0,0,10000,6800;"
80 PRINT#1,"SC79,86,0,90;"
90 '   TITLE & AXIS
100 PRINT#1,"PA83,70;"
110 PRINT#1,"SI0.3,0.55;SL0.2;SP2;"
120 READ X$:PRINT#1,"CP";-LEN(X$)/2;"0;"
130 PRINT#1,"LB";X$;CHR$(3)
140 PRINT#1,"SP1;SL;"
150 PRINT#1,"PA80.5,10;PD;PA85.5,10;"
160 FOR X=81 TO 84
170   PRINT#1,"PU";X;"10;"
180   PRINT#1,"SI0.2,0.3;CP0,-1;"
190   PRINT#1,"LB'";X;CHR$(3)
200 NEXT X
210 PRINT#1,"PU;PA80.5,10;"
220 FOR Y=0 TO 50 STEP 10
230   PRINT#1,"PD;PA80.5";Y+10
240   PRINT#1,"PU;CP-3.5,-0.25;LB";Y;CHR$(3)
250   PRINT#1,"PU80.5";Y+10:PRINT#1,"YT;"
260 NEXT Y
270 '   PLOT DATA
280 FOR X=81 TO 84
290   PRINT#1,"PU;PA";X;"10;"
300   READ A,B,C
310   PRINT#1,"SP2;FT4,0.08,45;RR0.7";A;"ER0.7";A
320   PRINT#1,"PR0";A
330   PRINT#1,"SP3;FT3,0.08,-45;RR0.7";B;"ER0.7";B
340   PRINT#1,"PR0";B
350   PRINT#1,"SP4;FT3,0.15,45;RR0.7";C;"ER0.7";C
360   PRINT#1,"PR0";C
370 NEXT X
380 PRINT#1,"SP1;SI0.3,0.45;"
390 PRINT#1,"PU;PA85";10+A/2;"LBA"+CHR$(3)
400 PRINT#1,"PA85";10+A+B/2;"LBB"+CHR$(3)
410 PRINT#1,"PA85";10+A+B+C/2;"LBC"+CHR$(3)
420 END
2000 '
2010 DATA "*** Bar Graph Example ***"
2020 DATA 12,14,9
2030 DATA 14,8,11
2040 DATA 15,11,13
2050 DATA 18,12,16
```

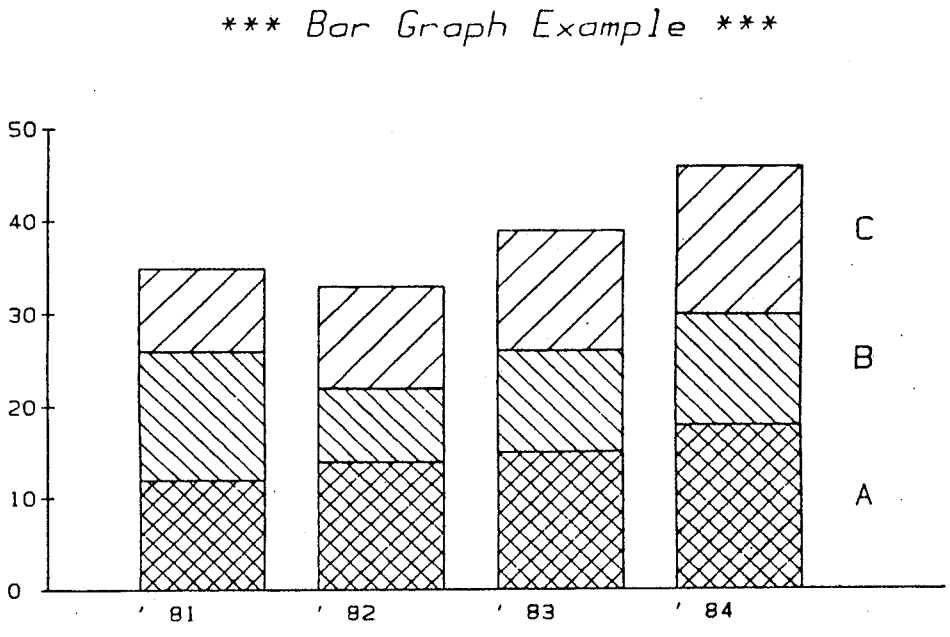
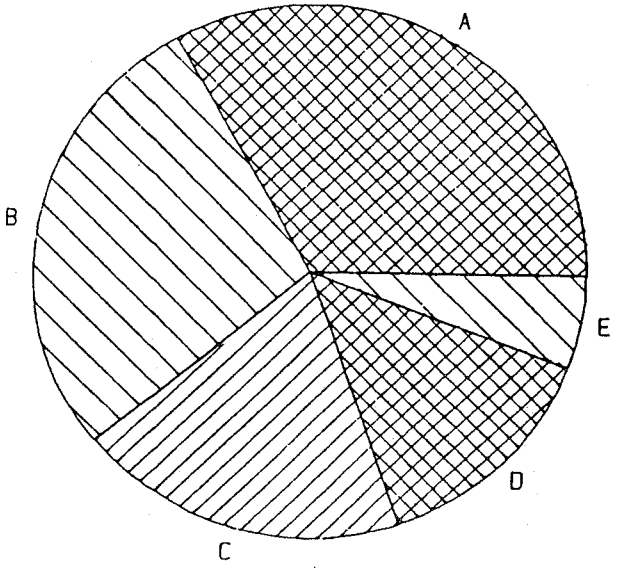


Fig.8-1 Bar Graph Example

Table 8-2 Example of Drawing Program (Pie Chart)

```
10 '
20 '  PIE CHART EXAMPLE
30 '
40 DIM D(4),D$(4)
50 OPEN"COM1:4800,N,8,2,CS65535,DS65535" AS #1
60 '  INITIAL SETTING
70 PRINT#1,"IN;"
80 PRINT#1,"IP0,0,10000,6800;"
90 PRINT#1,"SC0,250,0,170;"
100 ' TITLE
110 PRINT#1,"PA125,150;"
120 PRINT#1,"SI0.3,0.55;SL0.2;SP2;"
130 READ X$:PRINT #1,"CP";-LEN(X$)/2;"0;"
140 PRINT#1,"LB"+X$+CHR$(3)
150 PRINT#1,"SL;"
160 '  PLOT DATA
170 FOR I=0 TO 4
180   READ D$(I),D(I)
190   S=S+D(I)
200 NEXT I
210 PRINT#1,"FT3,1;"
220 PRINT#1,"SL;SI0.2,0.35;"
230 FOR I=0 TO 4
240   SB=360*D(I)/S
250   PRINT#1,"PA100,80;"
260   GOSUB 1000
270   PRINT#1,"WG55";SA;SB
280   PRINT#1,"EW55";SA;SB
290   SC=(SA+SB/2)*3.14195/180
300   PRINT#1,"PR";60*COS(SC);60*SIN(SC)
310   PRINT#1,"SP1;CP-.5,-.25;LB";D$(I);CHR$(3)
320   SA=SA+SB
330 NEXT I
340 PRINT#1,"PA200,130;SP1;"
350 FOR I=0 TO 4
360   PC=100*D(I)/S
370   PRINT#1,"LB";D$(I);" ";
380   PRINT#1,USING" ### (##.# %)";D(I);PC;
390   PRINT#1,CHR$(3)
400   PRINT#1,"CP;CP;"
410 NEXT I
900 END
1000 '  DEFINE FILL TYPE
1010 J=I MOD 3
1020 IF J=0 THEN PRINT#1,"FT4,3.0,45;SP2;":GOTO 1050
1030 IF J=1 THEN PRINT#1,"FT3,5.0,-45;SP3;":GOTO 1050
1040 PRINT#1,"FT3,3.0,45;SP4;"
1050 RETURN
2000 '  DATA
2010 DATA "*** Pie Chart Example ***"
2020 DATA A,120,B,100,C,70,D,50,E,20
```

*** Pie Chart Example ***



A	120	(33.3 %)
B	100	(27.8 %)
C	70	(19.4 %)
D	50	(13.9 %)
E	20	(5.6 %)

Fig.8-2 Pie Chart Example

NOTE : Be careful, in using this plotter in connection with the IBM Personal Computer, that the computer automatically stops and shows "Device Timeout" or "Device Unavailable" when making the plotter draw an extremely long line or print out a lot of characters or fill in a large area. To avoid it, therefore, be sure to add the following program. The underlined statement should be added after every command with long plotting time.

```
1000 PRINT#1,"WG2500,0,200;" : T=60 : GOSUB 60000
```

```
60000 '  delay time routine
60010 '  for  T  seconds
60020 GOSUB 60100
60030 VALUET=VALUE+T
60040 GOSUB 60100
60050 IF VALUE < VALUET THEN 60040
60060 RETURN
60100 VALUE$=TIME$
60110 VALUEH=VAL(LEFT$(VALUE$,2))
60120 VALUEM=VAL(MID$(VALUE$,4,2))
60130 VALUES=VAL(RIGHT$(VALUE$,2))
60140 VALUE=VALUEH*3600+VALUEM*60+VALUES
60150 RETURN
```

8.3 Consumables List

	Type	Norminel diameter (mm)	Part No.	Note (colors, etc)	Supplier
Pens	Ceramic pen (CERAMICRON)	0.2	SRM02	A (black), B (red), C (blue), D (green)	Pentel
		0.3	SRM03		
		0.4	SRM04		
	Technical ink pen (Mars plot)	0.25	757PL2CF	Recommend pen of 0.25 to 0.5 mm in line thichness.	Staedtler
		0.35	757PL3CF		
		0.5	757PL5CF		
	Fiber tip pen (water based ink)		671-7602	black, blue, red, green, violet, brown 6 pcs.	Hitachi
			671-7621	black only 6 pcs.	
			32HI03	1 (yellow), 2 (red), 3 (blue), 4 (orenge), 5 (greeen) , 6 (violet), 76 (brown), 9 (black), S (4 colors), S1 (5 colors)	Staedtler
	Fiber tip pen (oil based ink)		671-7603	black, blue, red, green, violet, brown 6 pcs.	Hitachi
			31HI03	2 (red), 3 (blue), 5 (green), 9 (black), S (4 colors)	Staedtler
Pen holders	Ceramic pen holder		672-7652		Hitachi
	Technical ink pen holder		75PL22H		Staedtler
	Fiber tip pen holder		75PL22R9	Only for pen part No. 32HI03, 31HI03, of Staedtler.	
Inks	Inks for ink pen (slow drying type)		748PL23	2 (red), 3 (blue), 5 (green), 62 (violet), 76 (brown), 9 (black)	Staedtler
	Inks for ink pen (fast drying type)		748PL	black only	Staedtler
			745	1 (yellow), 2 (red), 3 (blue), 5 (green), 6 (violet), 7 (brown)	